JOURNAL OF SOUTH AFRICAN BOTANY

Supplementary Volume No. 8

TAXONOMIC STUDIES ON LEUCOSPERMUM R. BR.

J. P. ROURKE

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JOURNAL
OF
SOUTH AFRICAN
BOTANY

SUPPLEMENTARY
VOLUME NO. 8

Published under the authority of the
Trustees
of the
National Botanic Gardens
of
South Africa.
Kirstenbosch,
Newlands, C.P.

Editor:
Prof. H. B. Rycroft

TAXONOMIC STUDIES ON LEUCOSPERMUM R.BR.

BY

J. P. ROURKE

Compton Herbarium, Kirstenbosch.

(With 71 figures)

14th April 1972

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TAXONOMIC STUDIES ON LEUCOSPERMUM R. BR.

Abstract

A brief historical review of previous taxonomic studies on *Leucospermum* is given. The principal diagnostic characters used in the present revision are evaluated. A complete taxonomic revision of the genus has been undertaken. All the relevant names have been typified and all the type specimens have been personally examined, except in a few cases where no type material could be traced. For each species the synonymy is given, the diagnostic characters are enumerated, brief historical comments are made where relevant and short ecological observations are provided. The distribution ranges of all taxa recognized have been mapped. In the present study, 47 species are upheld, arranged in 9 sections. 8 new species, *L. innovans*, *L. pluridens*, *L. praecox*, *L. fulgens*, *L. erubescens*, *L. utriculosum*, *L. profugum* and *L. secundifolium* are described. A key to the species is provided.

Mass gatherings have been used in several cases to investigate the variation ranges in complex groups. All but 3 taxa have been studied in the field. Although much of the variation in the polymorphic species *L. cuneiforme* appears to be random, a topocline in respect of leaf width was observed. Leaf width was found to increase from east to west over the distribution range of *L. cuneiforme*. A reappraisal of the taxonomic status of several complex vicarious populations was made, particularly those now upheld as *L. profugum* and *L. spathulatum*, *L. praecox* and *L. fulgens*, *L. catherinae* and *L. formosum*, *L. calligerum* and *L. wittebergense* and *L. alpinum* and *L. obtusatum*. An ecocline in the species here delimited as *L. oleifolium* is described. To demonstrate the cline, samples were obtained along a transect, over an altitudinal (and also ecological) gradient. When mass gatherings, made at intervals along the transect were evaluated, continuous variation in respect of growth habit, leaf pubescence and in the length and pubescence of the involucral bracts, was observed.

Chromosome counts for 16 species of *Leucospermum* are listed, 13 of which were made by the present author. The somatic number is $2n = 24$.

Observations on the reaction of certain species to burning are discussed. The majority of species of *Leucospermum* have no special adaptation to burning, regeneration taking place from the seeds. A few species are able to regenerate from the aerial stems but their survival rate is rather low and depends on the severity of the fire. The most effective adaptation to burning is the persistent rootstock or lignotuber. Development of the lignotuber was found to commence in the seedling stage, a few months after germination.

Studies on the pollination biology of the genus led the author to conclude that *Promerops cafer* (the Cape Sugarbird) and three species of sunbird, *Anthobaphes violacea*, *Nectarina famosa* and *Cinnyris chalybeus* were the most important pollen vectors. Certain Scarab beetles, particularly *Anisonyx ursus* and several *Trichostetha spp.* were found to play a significant but less important role in pollen transfer due to their short seasonal activity.

Phytogeographic studies showed that although the distribution range of *Leucospermum* extends as far north as Rhodesia, the greatest species density is found in a narrow belt along the southern Cape coastal flats where 30% of the known species occur. A high proportion of geographical and edaphic vicariads occur within this coastal belt, the surface of which has been disturbed by marine regressions and invasions since the Tertiary. It is suggested that this zone has been an important area of speciation since the Pleistocene.

The isolation and subsequent differentiation of certain montane populations such as *L. spathulatum* and *L. profugum*, *L. calligerum* and *L. wittebergense*, *L. alpinum* and *L. obtusatum*, is thought to have been caused by climatic fluctuations resulting from the hypothermal and hyperthermal phases during the Pleistocene.

In the light of available paleoclimatological evidence, the distribution of certain species of the section *Crassicaudex* occurring in the summer rainfall regions of southern Africa, suggests that these taxa have been in existence since the Early Tertiary. It is suggested that the species occurring in the south western Cape could have been derived from forms such as presently survive in south central Africa.

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Uittreksel

Taksonomiese Ondersoek van *LEUCOSPERMUM* R. Br.

'n Kort historiese oorsig van vorige taksonomiese werke op *Leucospermum* word gegee. Die belangrikste onderskeidende diagnostiese kenmerke in hierdie hersiening word evalueer. 'n Volledige taksonomiese hersiening is gedoen. Alle betrokke name is getipeer en alle tipeeksemplare is persoonlik bestudeer, behalwe in die paar gevalle waar geen tipemateriaal opgespoor kon word nie. Vir elke soort word die sinonieme aangegee, die diagnostiese kenmerke genoem; waar toepaslik word geskiedkundige kommentaar gelewer en bondige ekologiese observasies voorsien. Die verspreiding van alle erkende taksa word op kaarte aangedui. In die hersiening word 47 soorte erken en ingedeel in nege seksies. Agt nuwe soorte, naamlik *L. innovans*, *L. pluridens*, *L. praecox*, *L. fulgens*, *L. erubescens*, *L. utriculosum* *L. profugum* en *L. secundifolium* word beskryf. 'n Sleutel tot die soorte word voorsien.

Intensiewe versamelings moes in verskeie gevalle gemaak word om die variasie in komplekse groepe te ondersoek. Met die uitsondering van drie, is alle taksa in die veld bestudeer. Alhoewel baie van die variasies in die polimorfiese soort *L. cuneiforme* toevallig en ongeorden voorkom, kan 'n topokline in verband met die blaarwydte tog onderskei word. Die blaarwydte vermeerder van Oos na Wes oor die verspreidingsgebied van *L. cuneiforme*. Die taksonomiese status van verskeie saamgestelde plaasvervangende bevolkings is in heroorweging geneem, veral dié wat nou as *L. profugum* en *L. spathulatum*, *L. praecox* en *L. fulgens*, *L. catherinae* en *L. formosum*, *L. calligerum* en *L. wittebergense* en *L. alpinum* en *L. obtusatum* erken word. 'n Ekokline, in die soort hier gedefineer as *L. oleifolium*, word beskryf. Om die kline te demonstreer is monsters geneem langs 'n transek wat loop oor 'n gradient van hoogte- en ekologiese verskille. By die evaluasie van massaversamelings wat met tussenposes langs die transek gedoen is, is gevind dat 'n aaneenlopende variasie van groeivorm, blaarharigheid, en lengte en harigheid van die omwindselblare voorkom.

Chromosoomtellings vir 16 soorte, waarvan 13 deur die skrywer gedoen is, word aangegee. Die somatiese getal is $2n = 24$. Die invloed van brand op sommige soorte word bespreek. Die meeste *Leucospermum* soorte het geen spesiale aanpassings teen brand nie en regenerasie is van saad. 'n Paar soorte kon van die oorblywende bogrondse dele regenereer, maar hul oorlewensvermoë is laag en hang van die vuurintensiteit af. Die beste aanpassing teen vuur is die oorblywende wortelstok of „lignotuber", wat binne 'n paar maande na ontkieming alreeds begin ontwikkel.

'n Studie van die bevrugtingsbiologie van dié soort het die outeur laat glo dat *Promerops cafer* (Kaapse Suikerbekkie) en drie soorte „sunbird"—*Anthobaphes violacea*, *Nectarina famosa* and *Cinnyris chalybeus* die belangrikste stuifmeeldraers is. Sekere skarabtorre, veral *Anisonyx ursus* en verskeie *Trichostetha spp.* speel ook 'n belangrike maar beperkte rol weens hul kort aktiewe seisoen.

Plantgeografiese studies toon dat alhoewel *Leucospermum* tot so ver Noord as Rhodesië voorkom, die grootste spesiesdigtheid aangetref word in 'n smal strook langs die Suidelike Kaapse kusvlaktes waar 30% van hierdie soorte groei. Waar die oppervlakte deur die seeinvalle en -terugtrekkings sedert die Tertiêre tye versteur is, kom na verhoudings 'n groot aantal geografiese- en edafiese vergelykbares in hierdie kusstrook voor. Dit word voorgestel dat hierdie sone 'n belangrike plek vir die ontstaan van nuwe soorte gedurende die Pleistocene was.

Die isolasie en gevolglike differensiasie van sekere bergbevolkings soos *L. spathulatum* en *L. profugum; L. calligerum* en *L. wittebergense; L. alpinum* en *L. obtusatum* word toegeskryf aan klimaatskommelings gedurende die warm en koue tydperke van die Pleistocene.

In die lig van die beskikbare paleoklimaatsbewyse word voorgestel dat die verspreiding van sekere soorte van die seksie *Crassicaudex* wat in die somerreënval gebiede van Suidelike Afrika voorkom, reeds bestaan sedert die vroeë Tertiêre tye. Dit word voorgestel dat die soorte wat in die Suidwestelike Kaap voorkom, afkomstig kan wees van forme soos dié wat tans in die suide van Sentraal Afrika voorkom.

Aim and Scope of Work

The principal reason for undertaking the present research was to provide a modern taxonomic revision of the genus *Leucospermum*. Since the publication of the last complete revision, by Phillips and Stapf in 1912, a further thirteen species have been described. Moreover, large areas of South Africa have been opened up since that date and consequently have become more readily accessible to collectors, which has resulted in the accumulation of much *Leucospermum* material in local herbaria. As our knowledge of distribution ranges is extended, taxa previously considered to have been distinct have often been found to grade into each other. On the other hand, exploration has revealed the presence of several remarkable new species. The incorporation of this scattered information in a complete and critical revision of the whole genus has become an urgent necessity, particularly in view of the current horticultural popularity of many of the larger species. Consideration has also been given to observations on the cytology, biology and phytogeography of the genus.

Acknowledgements

The author wishes to express his sincere thanks and appreciation to his supervisor, Prof. E. A. Schelpe, for his guidance and encouragement while undertaking this project. I am also much indebted to Dr. P. Goldblatt for his assistance with cytological techniques and also to Dr. A. J. Hesse and Mr. F. Gess of the South African Museum, who so willingly identified the numerous insects collected during pollination studies.

In 1968, the award of the Smuts Memorial Fellowship by The University of Cape Town, made it possible for the author to visit several of the major herbaria in Europe. I am extremely grateful to the university for this assistance and for sanctioning the publication of this work. My thanks are also due to the Trustees of the National Botanic Gardens, Kirstenbosch, for granting me $3\frac{1}{2}$ months study leave in Europe. Publication costs were met by the Fourcade Bequest to the University of Cape Town.

The directors of the following institutes are sincerely thanked for the loan of material and, in many cases, for their hospitality when personal visits were possible: BOL, CT, STE, PRE, GRA, NH, NU, SRGH, K, BM, S, UPS, B, M, BR, Z, G, P, PH, FI, LY (abbreviated according to Lanjouw and Stafleu, 1964).

Finally, I would like to record my gratitude to Mr. Ion Williams, with whom I have travelled many thousands of miles in search of *Leucadendron* and *Leucospermum*, not only for his hospitality but also his splendid companionship on so many expeditions.

Historical Background

In 1689 Paul Herman's *Paradisi Batavi Prodronus* was published, containing the earliest known published description of a *Leucospermum*. Herman, who visited the Cape in 1672, described *L. conocarpodendron* (Salix conophora Africana . . .), which he had observed on the lower slopes of Table Mountain. During the ensuing fifty years, numerous other descriptions were published by such writers as Plukenet, Petiver, Ray and Boerhaave, and when, in 1753, the first edition of Linnaeus' *Species Plantarum* appeared, two species of *Leucospermum* were recognized. Between the publication of the *Species Plantarum* and the appearance of Thunberg's *Dissertation De Protea* in 1781, an additional four species were described, by Linnaeus, Bergius and N. L. Burman. Thunberg's enumeration listed nine species which at this stage were still grouped under *Protea*. The few additions to the genus that were published after this date were mainly in a review of *Protea* (sens. lat.) by Lamarck and in the *Botanists Repository* and *Paradisus Londinensis*.

The appearance of the rival publications of Salisbury (1809) and Brown (1810) saw the first use of the recently established generic divisions *Leucadendrum* and *Leucospermum*. The latter name of Brown was later to be conserved against *Leucadendrum* Salisb. The revisions of Salisbury and Brown listed twenty four and eighteen species respectively. These studies were to a large extent based on the collections of Masson, Niven and Roxburgh as well as living material from several of the great private collections of Cape Proteaceae which were fashionable in cultivation at that time.

Meisner's careful and lucid account of the genus for De Candolle's *Prodromus* in 1856, recognized twenty three species, four of which were newly described. Although this work purported to be a synthesis of all available information, it lacks the completeness it should have had for Salisbury's publications were not quoted at all.

In the last revision of the whole genus by Phillips and Stapf (1912), thirty one species were upheld, arranged in four sections. Despite its shortcomings, one hesitates to criticise this work, considering the hopelessly inadequate material available at the time.

Characters of Taxonomic Value

Growth Habit

Most species of *Leucospermum* are erect shrubs or small trees, usually with a single main stem, but a number of species have a prostrate growth form which is particularly characteristic of these taxa. In addition, certain species may be distinguished by having multiple stems at ground level, arising from a persistent rootstock, instead of a single main stem.

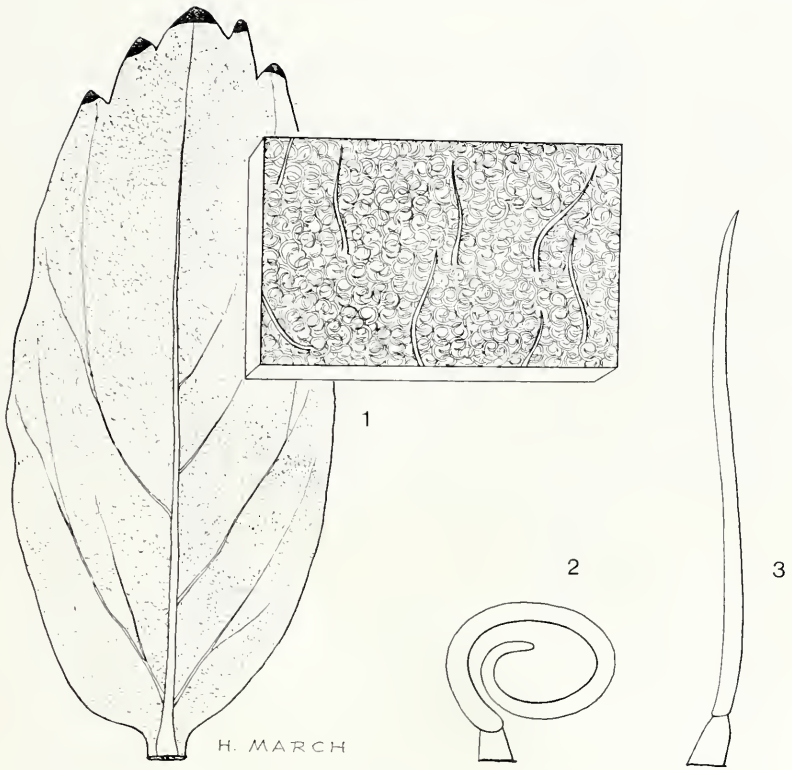


Fig 1.
Leaf pubescence in *Leucospermum*. The stylized leaf with an inset (1) shows the short dense indumentum of crisped hairs (2) interspersed with straight erect trichomes (3).

For example, while it is very difficult to separate *L. pedunculatum* and *L. prostratum* on herbarium material only, both these prostrate species have different growth habits. *L. pedunculatum* has a short stout trunk up to 30 cm in height from which numerous horizontally spreading stems arise, whereas in *L. prostratum* the stems develop from a subterranean lignotuber. Characters concerned with the biology of higher plants are seldom taken into account when classifications are proposed. The presence of a subterranean rootstock or lignotuber has been overlooked in the past but in the present study it is regarded as a very significant morphological and biological feature.

Leaves

Leaf characters have been greatly emphasised in previous classifications but usually without regard to their plasticity. The form, dimensions, pubescence and the number of teeth at the apex of the leaf are very useful characters. A fairly clear division can be made into species in which the leaves are entire with a single apical thickening, and those species in which the leaf apex is incised, bearing up to seventeen teeth.

It has been found that population studies are necessary to evaluate the range of variation in each taxon, for, while foliar characters may be very plastic in some species (e.g. *L. cuneiforme*, *L. cordifolium* and *L. oleifolium*), they may be surprisingly constant in others.

The presence or absence of pubescence on the leaves is generally a reliable diagnostic character. The type of pubescence found on the stems and leaves is so distinctive that it might even be regarded as a generic character. A fine matted indumentum of varying density is formed by numerous, short, crisped, coiled unicellular trichomes which may or may not have a few long straight unicellular trichomes interspersed among them (fig. 1).

The Inflorescence

In *Leucospermum* the inflorescence is a capitulum borne in an axillary position towards the apex of a flowering shoot. This is a diagnostic generic character. Generally, a single axillary bud develops into an inflorescence in the species having large inflorescences but in species having small inflorescences, nearly all the buds in the axils of the uppermost leaves on a flowering shoot may develop into inflorescences. Although the number of inflorescences per flowering shoot is not specifically diagnostic, it is usually characteristic of certain sections in the genus.

Involucral Bracts

There is comparatively little variation in the morphology of the involucral bracts but differences in their texture provide significant characters. A tough, cartilaginous texture characterises the involucral bracts in the majority of species. In these cases, the involucral bracts are tightly adpressed imbricate and are usually pubescent. On the other hand, species such as *L. tottum*, *L. vestitum* and *L. parile* may be distinguished by their glabrous bracts which are thin and papyraceous in texture.

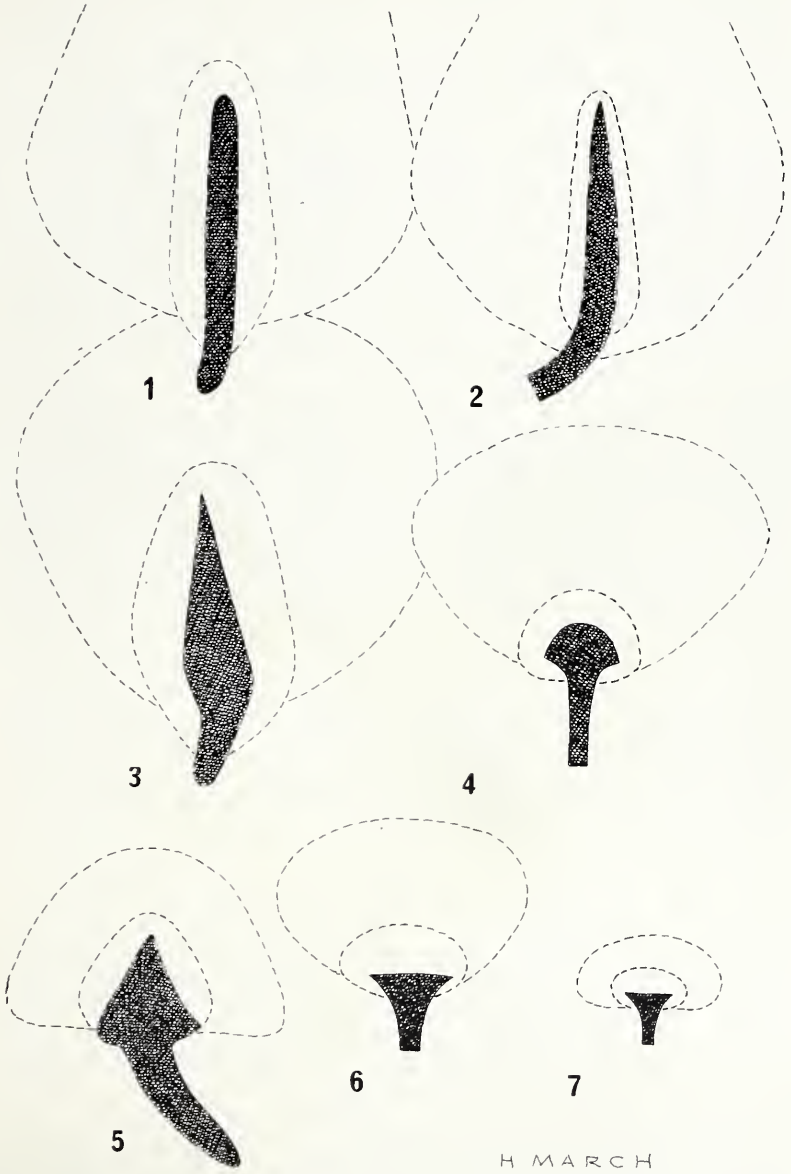


FIG 2.

The principal types of involucral receptacle in *Leucospermum*, as seen in longitudinal half section. The outermost broken line represents the position of the expanded styles, the innermost line represents the position of the bracteoles and the involucral receptacle is darkly hatched. (1) Cylindric obtuse; (2) narrowly conic acute; (3) conic acute; (4) spheroidal; (5) broadly conic depressed; (6 & 7) flattened.

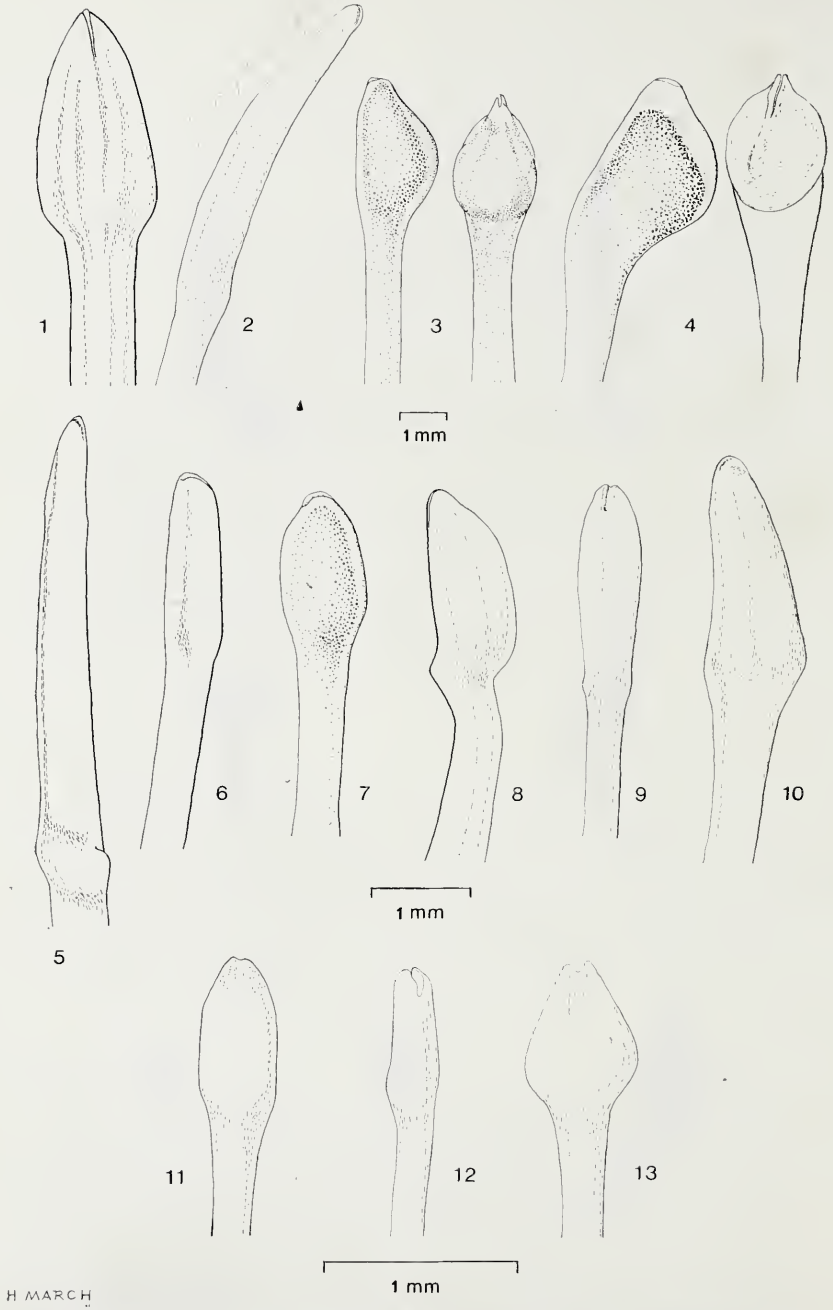


FIG 3.

The principal types of pollen presenter in *Leucospermum*. (1) *L. conocarpodendron;* (2) *L. grandiflorum;* (3) *L. vestitum;* lateral and abaxial view; (4) *L. patersonii*, lateral and abaxial view; (5) *L. reflexum;* (6) *L. saxosum;* (7) *L. utriculosum;* (8) *L. cordatum;* (9) *L. rodolentum;* (10) *L. praecox;* (11) *L. royenifolium;* (12) *L. mundii;* (13) *L. calligerum.*

The Involucral Receptacle

One of the most useful characters that has been largely overlooked by previous workers, is the form of the involucral receptacle. When the inflorescence is cut longitudinally into two equal halves the involucral receptacle can be seen in half section. The form of the involucral receptacle as seen in half section provides very reliable characters for grouping species. The basic shapes of the involucral receptacle are cylindric obtuse, narrowly conic acute, conic acute, broadly conic depressed and flattened (fig. 2).

Perianth

Perianth characters have also been overlooked by monographers in the past. The most obvious character of taxonomic value is the structure of the perianth tube. Although the perianth tube in most species is cylindric and of uniform diameter, there are several species forming a distinct group in which the perianth tube is narrowed proximally and inflated distally. *L. utriculosum* is the most extreme example of this type. Unfortunately this character is not easily observed in dried material but is quite obvious in fresh material.

Anthers

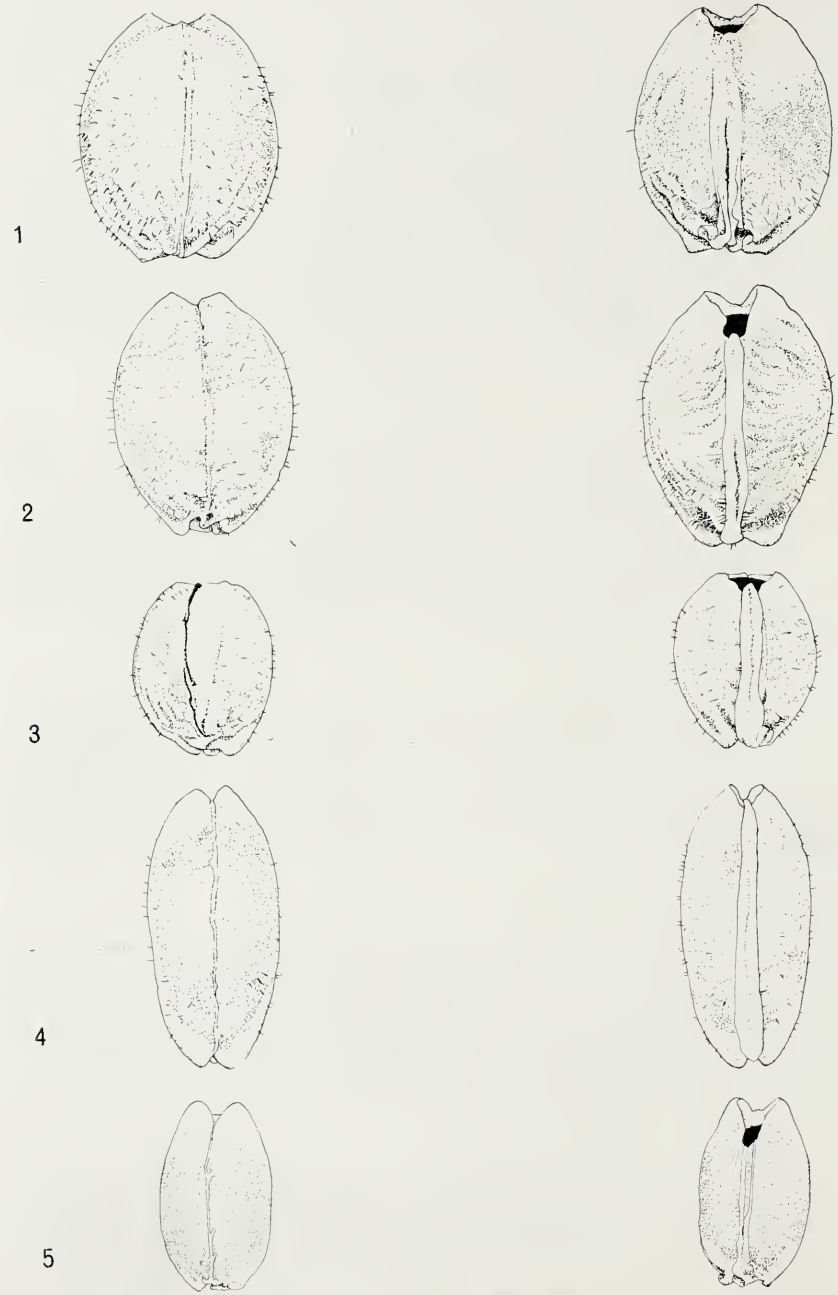
While the anthers are morphologically uniform throughout the genus and are normally sessile, certain species are described as having subsessile anthers. In the latter species, a short rudimentary filament 1,0—1,5 mm long connects the anther to the perianth limb. Those taxa, grouped together in the section *Brevifilamentum* on overall morphological similarity, are also characterised by having subsessile anthers.

Pollen Presenter

The considerable range of variation in the morphology of the pollen presenter provides characters of great taxonomic value at specific level. In a previous paper the definition and use of this term were discussed as well as the taxonomic importance of this character in other genera of the Proteaceae (Rourke, 1969). Since no adequate language exists to describe in full the morphology of this organ, the principal types have been illustrated (fig. 3).

Fruits

Little importance can be attached to the fruits as a taxonomic character for species delimitation. Differences in the dimensions are slight while the morphology is surprisingly uniform, varying only from ovoid to cylindric (fig. 4).



HERRAT MARCH

Taxonomy

Criteria used for delimitation of Species

In the preparation of this revision, the author has attempted to produce a classification of naturally occurring populations. Differences and similarities between living populations have been sought, while great stress has been laid on the determination of their exact distributional limits. Where populations have been found to be variable or where careful comparison of two or more populations has been necessary, mass gatherings throughout their range have been made in order to assess the extent and significance of the variation. Here, I have followed the methods prescribed by Anderson (1941) which have enabled me to make a more complete and objective evaluation of variability than the range of available herbarium material would normally have permitted.

The phenomenon of vicarism was found to be very widespread. In this connection it is worth quoting Cain's clear definition of vicarious species: "Vicarious species are closely related allopatric species which have descended from a common ancestral population and attained at least spatial isolation" (Cain, 1944: 265). Although as far as *Leucospermum* is concerned, it is at this stage impossible to prove that two vicarious taxa are descended from a common ancestral population, it can at least be inferred by their morphological similarity.

The assignation of rank to vicarious taxa even when separated by significant geographical intervals, is not always easy and although every effort has been made to evaluate the distinctness of these taxa objectively, the decision as to whether they should be accorded specific or subspecific rank is often unavoidably subjective. Nevertheless, some morphological criteria must be followed and for this purpose the suggestions of Hedberg have been adopted. Thus, populations separated by discontinuous variation in at least two (preferably more) independent characters, are distinguished at the level of species while distinct discontinuity in a single character together with geographical isolation, is used as the basis for recognising subspecies (Hedberg, 1958: 193).

The genus has been divided into nine sections, each containing morphologically similar taxa. Complex groups within each section are discussed directly

Fig. 4.

The small variation range in the fruits of *Leucospermum* showing the abaxial (left) and adaxial (right) views of the most extreme types in the genus. (1) *L. patersonii;* (2) *L. glabrum;* (3) *L. praecox;* (4) *L. praemorsum;* (5) *L. mundii.*

after the sectional diagnosis. All specimens (including types) quoted in this work have been examined by the present author except where the contrary is stated.

Localities

Due to the advanced stage this work had reached by the time the one degree grid system was generally adopted in South Africa, specimens are still cited according to the magisterial districts as defined in 1964.

Leucospermum R. Br. in Trans. Linn. Soc. Lond. **10:** 95 (1810),—nom. cons.; Roem. & Schult. Syst. Veg. **3:** 356 (1818); Sprengel, Syst. Veg. **1:** 464 (1825); Roem. & Schult., Mant. Syst. Veg. **3:** 266 (1827); Endlicher, Gen. Pl. fasc. **5:** 337 (1837); Harv., Gen. S. Afr. Pl.,: 291 (1838); Meisn. in DC., Prodr. **14:** 253 (1856); Benth. & Hook., Gen. Pl. **3:** 170 (1883); Engler in Nat. Pfl. Fam. **3** (1): 137 (1888); Phillips & Stapf in Fl. Cap. **5:** 610 (1912); Thonner, Fl. Pl. Afr.: 171, t. 33 (1915); Phillips, Gen. S. Afr. Fl. Pl. ed 2,: 257 (1951); Hutch., Gen. Fl. Pl. **2:** 292 (1967). Type: *L. hypophyllocarpodendron* (L.) Druce.

Conocarpus Adanson, Famil. de Plant. **2:** 284 (1763), partly, as to citation of Boerh. t. 196 & t. 198;—non L. (1753).

Lepidocarpus Adanson, Famil. de Plant. **2:** 284 (1763), partly, as to citation of Pluk. Phyt. t. 200 f. 2.

Leucadendrum Salisb., Parad. Lond. sub. t. 67 (1807); Knight, Cult. Prot.: 52 (1809).

Leucadendron O. Kuntze, Rev. Gen. Pl. **2:** 578 (1891); —non L. (1753).

Small trees or shrubs, single or with multiple stems at base, 1,0—5,0 m in height, or sprawling prostrate shrubs with decumbent stems, often forming low mats, 1,0—5,0 m in diam. *Leaves* alternate, loosely ascending or imbricate, sessile or petiolate 1,5—14,0 cm long; linear, elliptic, oblanceolate, oval, obovate or spathulate; entire or with up to 17 teeth at apex; glabrous or pubescent, often covered with a short indumentum of fine crisped hairs interspersed with erect silky trichomes. *Inflorescences* axillary capitula, sessile to pedunculate, solitary or in groups of up to 10 per flowering shoot; globose to depressed globose, ovoid or turbinate 2,0—15,0 cm in diam. *Involucral receptacle* cylindric, conic, conic depressed, globose or flat. *Involucral bracts* linear or ovate, acute, acuminate or recurved; tightly imbricate to subsquarrose; cartilaginous or membranaceous; glabrous or pubescent; small, inconspicuous and greenish when fresh. *Bracteoles* lanate proximally, puberulous or glabrous distally; occasionally enlarging and becoming woody in post pollination phase. *Perianth* 1,5—5,5 cm long, tubular-cylindric in bud; straight or adaxially curved;

white, pink, yellow, orange or crimson; the three adaxial perianth claws fused to form a sheath, the abaxial perianth claw increasing in length and becoming separated from the adaxial sheath for ¾ of its length but remaining fused at the base; Perianth tube 0,3—1,0 cm long, cylindric or narrowed proximally and inflated distally; perianth limbs ovate or lanceolate, acute. *Anthers* sessile or subsessile, the connective produced into a pointed or rounded apical boss. *Style* straight or adaxially curved, 1,0—8,0 cm long, elongating rapidly and arching up between the adaxial perianth sheath and the partially free abaxial perianth claw, often tapering subterminally; 1,0—2,0 mm in diam., or filiform. *Pollen presenter* cylindric, clavate, ovoid, conic or obliquely turbinate; stigmatic groove terminal or oblique. *Ovary* 1,0—2,0 mm long, puberulous, scarcely differentiated from the base of the style; one chambered, ovule single, pendulous. *Hypogynous scales* 4; 1,0—3,0 mm long, linear or deltoid-subulate. *Fruit* an ovoid to cylindric nut 4,0—8,0 mm long, broadly emarginate at base, glabrous or minutely puberulous.

Diagnostic Characters: The genus is distinguished by having axillary capitula with small insignificant involucral bracts; by the three adaxial perianth segments being fused into a sheath, with the abaxial perianth segment elongating and separating for the greater part of its length but remaining fused proximally to form a distinct perianth tube; by the prominent exerted coloured styles, straight or adaxially arcuate, and the nut-like fruits, broadly emarginate at the base.

Distribution: 47 species, ranging from Namaqualand throughout the south western, southern and eastern Cape to Natal, the eastern Transvaal, Swaziland and the Chimanimani mountains, Rhodesia.

Key to the Species of Leucospermum

1	Styles 10—30 mm long, usually not exceeding 28 mm in length	2
1′	Styles 31 mm or more long, usually exceeding 35 mm in length	25
2	Leaves with 2 or more teeth at apex	3
2′	Leaves entire, with a single apical thickening	14
3	Involucral receptacle flat	4
3′	Involucral receptacle conic, acute	7
4	Leaves 5—7 mm wide	5
4′	Leaves 10—85 mm wide	6
5	Leaves very narrowly oblanceolate, attenuate at base, bracteoles acute	*47. saxatile*
5′	Leaves linear, obtuse at base, bracteoles abruptly acuminate	*46. gracile*
6	Leaves ovate, lanceolate or oblong, usually entire, rarely with 2—5 teeth at apex	*44. oleifolium*
6′	Leaves oblanceolate to broadly obovate, with 7—17 teeth at apex	*45. mundii*

7 Leaves canescent, with a dense, greyish, crisped indumentum 8
7′ Leaves glabrous or glabrescent 11

8 Stems erect, leaves ascending loosely imbricate, very rarely subsecund 9
8′ Stems prostrate, leaves secund *28. hypophyllocarpodendron*

9 Leaves linear, broadly canaliculate 10
9′ Leaves oblong to oblanceolate, plane *30. rodolentum*

10 Involucral bracts glabrous, membranaceous, subsquarrose *31. parile*
10′ Involucral bracts tomentose, cartilaginous, tightly adpressed imbricate *29. tomentosum*

11 Stems erect, leaves ascending, loosely imbricate 13
11′ Stems prostrate, leaves usually secund or at least some of them secund 12

12 Pollen presenter cylindric obtuse to clavate . . . *28. hypophyllocarpodendron*
12′ Pollen presenter conic-ovoid *36. heterophyllum*

13 Perianth puberulous, leaves 4—10 mm wide *11. muirii*
13′ Perianth villous, leaves 8—15 mm wide *10. truncatum*

14 Styles very strongly adaxially arcuate *21. cordatum*
14′ Styles straight or very slightly adaxially arcuate 15

15 Pollen presenter conic-ovoid 16
15′ Pollen presenter cylindric-clavate 18

16 Involucral bracts membranaceous, forming a distinct, multiseriate involucre . . . 17
16′ Involucral bracts cartilaginous, involucre indistinct *33. calligerum*

17 Leaves pubescent, oval or oblong *37. truncatulum*
17′ Leaves glabrous, elliptic to ovate *38. bolusii*

18 Leaves secund 19
18′ Leaves ascending, loosely imbricate 20

19 Leaves 1—2,5 cm long *42. obtusatum*
19′ Leaves 5—8 cm long *43. secundifolium*

20 Stems erect 21
20′ Stems trailing 24

21 Leaves glabrous or glabrescent 22
21′ Leaves pubescent with a fine crisped indumentum *34. wittebergense*

22 Leaf apices obtuse 23
22′ Leaf apices acute *35. royenifolium*

23 Leaves obovate to spathulate-elliptic, 8,5—13,0 mm wide *41. alpinum*
23′ Leaves linear-spathulate, 1,5—6,0 mm wide *42. obtusatum*

24 Acaulescent shrubs, with stems arising from a subterranean rootstock; perianth and style deep yellow at anthesis becoming orange or red with age . . *39. prostratum*
24′ Caulescent shrubs, with stems arising from the crown of a stout main trunk up to 30 cm in height; perianth and style creamy white at anthesis becoming pinkish carmine with age *40. pedunculatum*

25 Styles 3,0—3,5 cm long *32. arenarium*
25′ Styles exceeding 3,5 cm in length 26

26 Involucral bracts loosely arranged, linear-lanceolate *26. praemorsum*
26′ Involucral bracts adpressed imbricate (not loosely arranged), lanceolate to ovate 27

27 Involucral receptacle narrowly cylindric, obtuse 28
27′ Involucral receptacle narrowly conic acute, conic acute, or conic depressed . . . 32

28 Styles 7,0—7,5 cm long, leaves grey, canescent, with a dense, permanent crisped indumentum *27. reflexum*
28′ Styles less than 7,0 cm long, leaves glabrous or glabrescent 29

29 Pollen presenter very narrowly conic acute, scarcely differentiated from the style; recorded from Rhodesia, Transvaal, Swaziland and Natal 30
29′ Pollen presenter conic acute; recorded from the Cape and Natal 31

30 Leaves linear to oblanceolate, slightly falcate, with prominently raised reticulate and parallel veins on surface *4. gerrardii*
30′ Leaves elliptic, smooth, lacking prominently raised veins on surface . *1. saxosum*

31 Leaves oblanceolate 0,6—3,0 cm wide *2. cuneiforme*
31′ Leaves very broadly oblanceolate to obovate, 3,0—5,0 cm wide . . *3. innovans*

32 Style 7,0—8,0 cm long, pollen presenter set almost at right angles to the style . . 33
32′ Style less than 7,0 cm long, pollen presenter in line with the style 36

33 Involucral bracts of immature inflorescences tightly adpressed imbricate, glabrous to glabrescent, margins and apex minutely ciliate 35
33′ Involucral bracts of immature inflorescences squarrose, margins with dense long cilia, apices crinite 34

34 Leaves pubescent with a greyish canescent indumentum of fine crisped hairs; apex with 2—4 teeth; perianth and style yellow at anthesis . . . *24. grandiflorum*
34′ Leaves glabrous, deep green in fresh state; leaves usually entire or rarely with 2—4 teeth; perianth and style bright orange at anthesis *25. gueinzii*

35 Leaves permanently pubescent, covered with a dense indumentum of fine crisped hairs, sessile *22. formosum*
35′ Leaves glabrous, petiolate with a prominently attenuate base . . *23. catherinae*

36 Perianth tube inflated distally, narrowed proximally 37
36′ Perianth tube cylindric, of uniform diameter 42

37 Stems decumbent, trailing 38
37′ Stems erect 39

38 Style 4,5—6,2 cm long; leaves glabrous or glabrescent, usually with 2 or 3 teeth at apex *15. profugum*
38′ Style 3,0—4.0 cm long; leaves beset with a fine indumentum of short crisped hairs; usually entire, rarely with 2 or 3 teeth at apex *14. spathulatum*

39 Pollen presenter conic, acute 40
39′ Pollen presenter ovoid, clavate or cylindric, obtuse 41

40 Leaves oblanceolate to oblong, with up to 4 teeth at apex; perianth villous *9. fulgens*
40′ Leaves obovate to broadly obovate, with 6–11 teeth at apex; perianth puberulous *8. praecox*

41 Inflorescences in groups of 2–8 slightly assymetrical; perianth velutinous; styles almost straight *12. erubescens*
41′ Inflorescences solitary or in groups of up to 2; perianth beset with long, spreading silky trichomes; styles adaxially curved *13. utriculosum*

42 Pollen presenter obliquely turbinate (hoof shaped) 43
42′ Pollen presenter ovoid or conic, acute 44

43 Perianth claws lanate; leaves broadly oblong, always with 3–8 teeth at apex *20. patersonii*
43′ Perianth claws puberulous; leaves ovate to oblong, entire or with up to 6 teeth at apex *19. cordifolium*

44 Pollen presenter conic, acute 45
44′ Pollen presenter ovoid or obliquely ovoid, acute 47

45 Involucral bracts with long, acuminate recurved apices 46
45′ Involucral bracts acute to acuminate apices imbricate, not recurved *5. conocarpodendron*

46 Stems with a villous to arachnoid, cinereous indumentum *7. pluridens*
46′ Stems glabrous *6. glabrum*

47 Involucral bracts membranaceous, glabrous 48
47′ Involucral bracts cartilaginous, tomentose *18. lineare*

48 Styles straight at maturity, the lowermost horizontally patent; perianth pink *17. tottum*
48′ Styles adaxially arcuate at maturity; perianth orange or red . . . *16. vestitum*

Sect. 1. CRASSICAUDEX Rourke, sect. nov.

Frutices erecti, caulibus plurimis, a caudice subterraneo lignoso persistenti exorientibus. Folia oblanceolata cuneata vel late cuneatissima, 2–10 dentata. Receptaculum involucrale cylindricum.

Erect shrubs with numerous stems arising from a woody, subterranean, persistent rootstock. Leaves oblanceolate cuneate to very broady cuneate. Involucral receptacle cylindric.

Type: *L. cuneiforme* (Burm. f.) Rourke

L. gerrardii is the only sharply delimited species in the section. *L. saxosum* and *L. innovans* are sufficiently distinct morphologically and sufficiently isolated geographically, to be accorded specific rank.

The remaining variable complex extending from the Caledon district eastwards to Qolora mouth in the Transkei, has been subdivided into several species in the past. Differences in growth habit can be very marked, particularly as the type of habitat occupied may vary from stabilised coastal sand dunes to the margins of temperate evergreen forest, or arid fynbos fringing the Karoo. Consequently, the variety of growth habits assumed is considerable, ranging from low, stunted, almost prostrate shrubs, to arborescent shrubs reaching 3 m or more in height. Climatic and edaphic factors as well as the frequency of burning have a very significant effect on the modification of growth habits within this complex.

Variation in the size of the inflorescence is also evident but cannot be correlated with any other character. The considerable range in the form and dimensions of the leaves together with differences in the degree of toothing of the

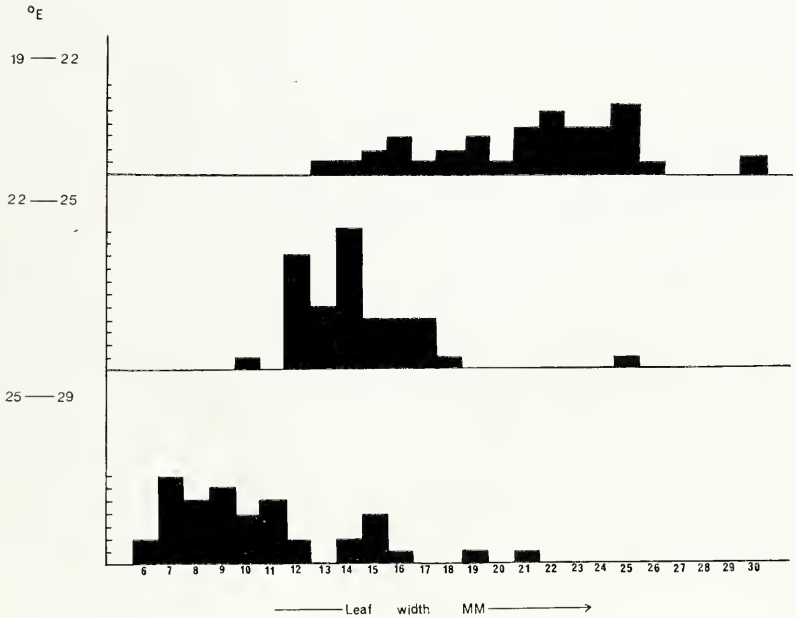


FIG. 5.
Histograms showing the topocline in the leaf width of *Leucospermum cuneiforme* (Burm. f.) Rourke. The leaf width increases from east to west.

leaf apex, have been the major causes for subdivision by previous authors. However, a topocline in respect of leaf width was found.

To demonstrate this cline, the entire distribution range of the complex was divided into 3 approximately equal divisions: Caledon—Mossel Bay (19°—22°E); Mossel Bay—Gamtoos River mouth (22°—25°E); Gamtoos River mouth—Qolora mouth (25°—29°E). The leaf width of 30 collections occurring within each of these divisions was measured (from specimens in NBG, SAM, BOL, PRE) and plotted as a series of histograms. A clear trend from narrow leaves in the east to broader leaves in the west is observable (fig. 5). The arrangement of the leaves illustrated in Fig. 6 to show variation in apical toothing and in overal dimensions, more or less follows the direction of the cline.

While local races may appear quite distinct, continuous variation in all characters throughout the complex suggests that only one variable species, *L. cuneiforme*, should be recognised.

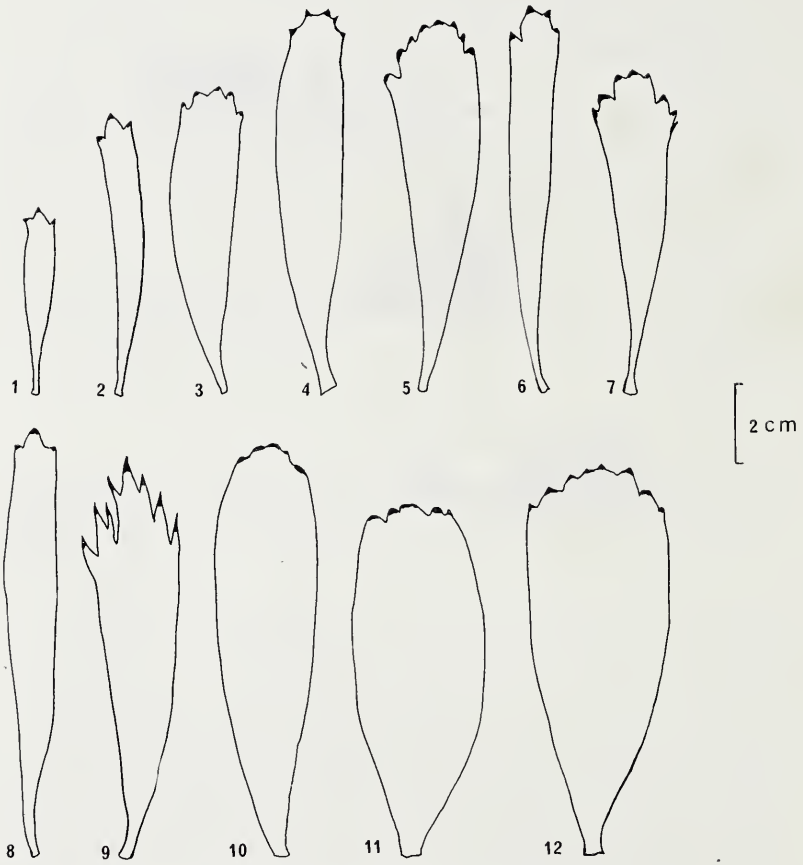


FIG. 6.
Variation in the leaves of *Leucospermum cuneiforme* (Burm. f.) Rourke: (1) *Compton* 20290; (2) *Rycroft* 2502; (3) *Barker* 10497; (4) *Rourke* 616; (5) *Barker* 10500; (6) *Middlemost* 2053; (7) *Denman* 21; (8) *Compton* 7546; (9) *Lewis* 5337; (10) *Williams* 1056; (11) *Rourke* 950; (12) *Rourke* 279.

(1) **Leucospermum saxosum** S. Moore in J. Linn. Soc. (Bot) **40:** 185 (1911). Type: Crags of Chimanimani mts., *Swynnerton* 652 (Holotype BM; isotypes K, B).

An erect shrub to 2,0 m in height with numerous stems arising from a woody underground rootstock. *Stems* erect, 3,0—8,0 mm in diam., covered with a dense indumentum of fine crisped hairs, sparsely interspersed with long (2,0—3,0 mm), erect trichomes. *Leaves* oblanceolate cuneate to elliptic to almost linear, 5,5—11,5 cm long, 0,6—2,5 cm wide, attenuate to petiolate at base; apex usually 3–6 toothed, occasionally entire. *Inflorescences* solitary, occasionally 2-nate; ovoid, 4,0—6,0 cm in diam., pedunculate, peduncle 1,0—1,5 cm long. *Involucral receptacle* narrowly cylindric 2,5—3,0 cm long, 0,5 cm wide *Involucral bracts* ovate, 6,0—8,0 mm long, 2–3 seriate, imbricate, tomentose, cartilaginous; apex abruptly acute. *Bracteoles* very broadly obovate, apex acute; tightly clasping the perianth. *Perianth* 3,0—3,5 cm long, yellow-orange becoming crimson with age. *Perianth tube* 6,0 mm long, infundibuliform, inflated and minutely puberulous distally, narrowed and glabrous proximally. *Perianth claws* villous. *Perianth limbs* linear 3,0 mm long, sparsely villous. *Anthers* sessile, 2,0 mm long elliptic. *Style* 4,5—5,5 cm long, slightly abaxially arcuate, orange, becoming reddish with age. *Pollen presenter* very narrowly conic acute, scarcely differentiated from style, 2,0—3,0 mm long; stigmatic groove terminal. *Hypogynous scales* linear subulate, 2,0 mm long.

Diagnostic Characters: The infundibuliform perianth tube, the very narrowly conic-acute pollen presenter (scarcely differentiated from the style) and the oblanceolate-elliptic leaves very attenuate to petiolate at the base, serve to distinguish *L. saxosum* from related taxa.

Distribution, Ecology and Biology: L. saxosum was originally discovered in 1906 by Swynnerton in the Chimanimani mountains (eastern highlands of Rhodesia) and has subsequently been recorded at several points along this range on both the Rhodesian and Portuguese sides of the border. Outlying populations have recently been discovered at the northern end of the eastern Transvaal Drakensberg.

L. saxosum is a fire resistant species able to regenerate after burning from a persistent rootstock. No personal field observations on this species have been made but collectors records indicate that it occurs between 4 000 and 7 000 ft. in montane grassland or associated with Proteaceous scrub and sclerophyll. In the Chimanimani range it is apparently confined to rocky, well-drained slopes and craggy outcrops of Frontier Quartzite while the population in the

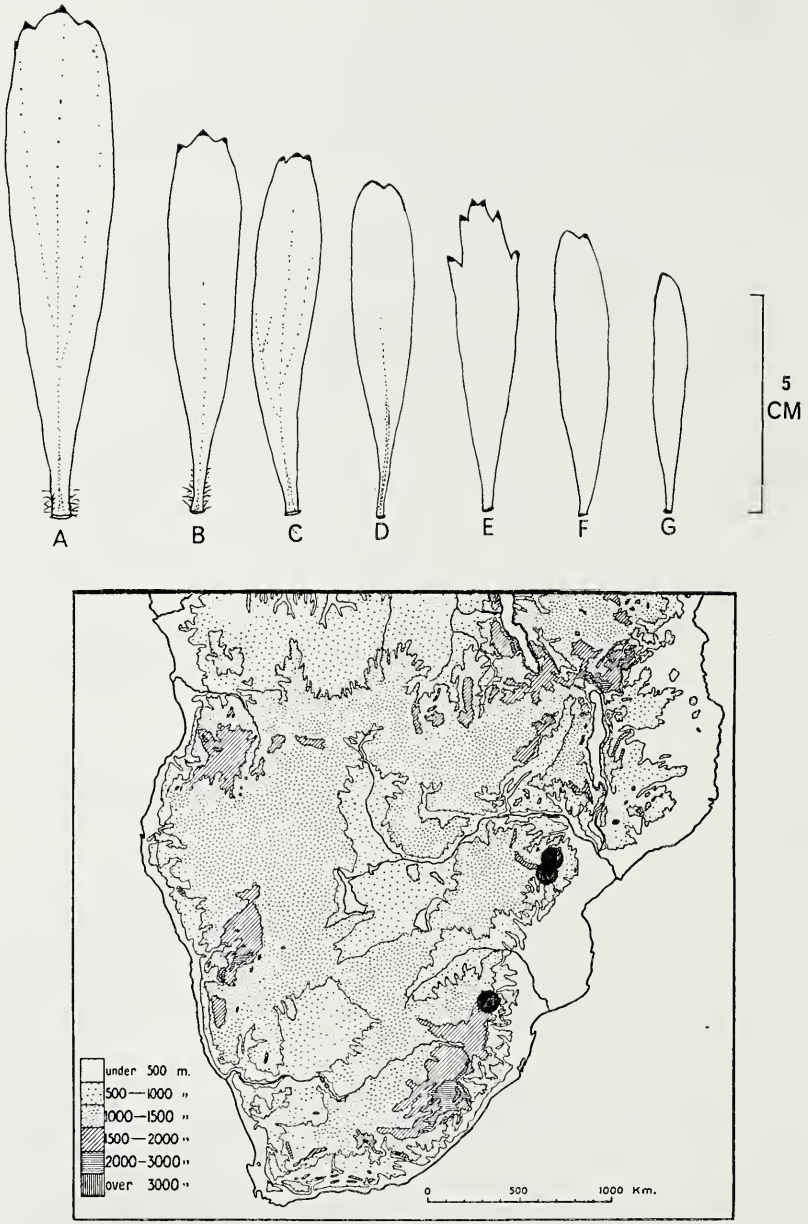


FIG. 7.

Leucospermum saxosum S. Moore, showing distribution and leaf variation (A) *Watermeyer* s. n. (SRGH 174716); (B) *Rutherford-Smith* 164; (C) *Leach* 9034; (D) *Loveridge* A70; (E) *Parke* 3175; (F) *Thompson* 5; (G) *Taylor* 1792.

eastern Transvaal Drakensberg occurs on Wolkberg Quartzite. A fairly high summer rainfall of 45—60″ p.a. is recorded in addition to frequent mists.

Inflorescences are produced erratically throughout the year but the peak of the flowering period is from September to December.

Specimens Examined:

SOUTH AFRICA

TRANSVAAL

LETABA: On the Drakensberg escarpment overlooking Sekororos location (near The Downs) along a stream on slopes facing Penge, May, *L. C. Thompson* s.n. (PRE, K).

PILGRIMS REST: Western Hebronsberg north east of Mac's Mine, in south facing kloof, Aug., *P. Vorster* s.n. sub. PRE 30775 (PRE).

BARBERTON: Barberton, Transvaal, 3100 ft. *F. A. Rogers* 30038 (K, G) (This may be a dubious record).

RHODESIA

MELSETTER: Chimanimani mts., Sept., *Swynnerton* 652 (BM, K, B); Martin forest reserve, Nov., *Mavi* 663 (SRGH, NBG); Chimanimani mts., July, *Beard* 817 (NU); Stonehenge, Chimanimani mts., June, *Hall* 235 (BOL, SRGH); Chimanimani mts., near streams, Oct., *Plowes* 1212 (SRGH); June, *Munch* 128 (SRGH, K); June, *Wild* 2958 (SRGH, K); Stonehenge, Chimanimani mts., May, *Chase* 6914 (SRGH, PRE, K); Martin forest reserve, Jan., *Rail* (SRGH, PRE, K); Small rocky valleys between Uncontoured Peak and Turret Towers, Feb., *Goodier* 188 (SRGH, PRE, K); South of Ben Nevis, Sept., *H. C. Taylor* 1756 (SRGH); Chimanimani mts., near mountain club hut, Nov., *Parke* 3175 (SRGH, NBG); Upper Chimanimani mts., Aug., *Watermeyer* s.n. (SRGH 174716); Mount Mahoendgi, among rocky outcrops, Aug., *Palgrave* CH 61 (SRGH); Mount Peza, Oct., *Munch* 290 (SRGH); Martin falls, Sept., *H. C. Taylor* 1792 (SRGH); Melsetter, Chimanimani, Sept., *Loveridge* A70 (SRGH, PRE); Gwasha, on first range, Sept., *Rutherford-Smith* 164 (SRGH); Plateau in the Chimanimani, May, *Leach* 9034 (SRGH); Stonehenge Plateau, Chimanimani mts., Feb., *Phipps* 355 (SRGH, BR); Chimanimani mts., July, *Thompson* 5 (SRGH, PRE); Mountain hut, Chimanimani, May, *Noel* 2115 (SRGH).

MOZAMBIQUE

Manica and Sofala, Manica Chimanimani, River Inhanadri, July, *Pedro and Pedrogão* 7207 (PRE); Manica and Sofala, Manica Chimanimani, River Mevumosi, July, *Pedro and Pedrogao* 7267 (PRE).

(2) **Leucospermum cuneiforme** (Burm. f.) Rourke in Jl S. Afr. Bot. **33:** 263 (1967).

Leucadendron cuneiforme Burm. f., Fl. Cap. Prodr.: 4 (1768). Type: *Oldenland* in herb. Burman (G), isotype in herb. Schreber (M).

Protea elliptica Thunb., Diss. Prot.: 22 (1781). Type: *Thunberg*, Cap. b. spei, sheet 2915 in herb. Thunberg (UPS).

Leucadendrum ellipticum (Thunb.) Salisb. ex Knight in Knight, Cult. Prot.: 53 (1809).

Leucospermum ellipticum (Thunb.) R. Br. in Trans. Linn. Soc. Lond. **10:** 98 (1810); Dandy and Taylor in J. Bot., Lond. **71:** 157 (1933).

Leucadendron ellipticum (Thunb.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Leucadendrum phyllanthifolium Salisb. ex Knight in Knight, Cult. Prot.: 55 (1809). Type: "3 ft. high, elevated dry places, Zwellendam, *Niven* 49", holotype in herb. Salisbury (K).

Leucospermum phyllanthifolium (Salisb. ex Knight) Fourcade in Trans. R. Soc. S. Afr. **21:** 97 (1932).

Leucadendrum cervinum Salisb. ex Knight in Knight, Cult. Prot.: 55 (1809). Type: "4—5 ft. high, rocky elevated places", *Niven* s.n. in herb. Salisbury (K).

Leucospermum attenuatum R. Br. in Trans. Linn. Soc. Lond. **10:** 96 (1810); Phillips & Stapf in Fl. Cap. **5:** 618 (1912). Type: Specimen at British Museum labelled "2 Leucospermum attenuatum" in Brown's hand, taken as type (BM).

Protea attenuata (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 566 (1816).

Leucospermum zeyheri Meisn. in DC., Prodr. **14:** 255 (1856). Types: Stony hills, Buffelsjachts river, Swellendam, *Zeyher* 3682, syntype in herb. Meisner (NY); On hills near Port Elizabeth, *Zeyher* 3680, type number (SAM, PRE).

Leucospermum septemdentatum Gandoger and Schinz in Bull. Soc. bot. Fr. **60:** 53 (1913). Type: Port Elizabeth, *Laidley* 185 in herb. Schinz (Z).

Shrubs to 3,0 m in height, with many stems arising from a stout subterranean rootstock, occasionally with a single main stem if unburnt; basal branches pustulate. *Flowering stems* erect, 0,3—0,7 cm in diam., covered with a dense cinereous indumentum of short crisped hairs. *Leaves* linear cuneate to broadly oblanceolate cuneate, 4,5—11,0 cm long, 0,6—3,0 cm wide, apex 3–10 toothed, margins horny, glabrous. *Inflorescences* ovoid, 5,0—9,0 cm in diam.; usually solitary, occasionally in groups of 2 or 3; pedunculate, peduncle to 1,5 cm long. *Involucral receptacle* narrowly cylindric obtuse, 2,5—4,5 cm long, 0,6 cm wide. *Involucral bracts* ovate to broadly ovate acute, 0,8—1,0 cm long, 0,6 cm wide, tightly imbricate, cartilaginous, tomentose cinereous. *Bracteoles* ovate acute to acuminate, 1,0—1,2 cm long, 0,7 cm wide, cartilaginous, clasping perianth, densely lanate proximally, sericeous distally, margins ciliate. *Perianth* 2,5—4,0 cm long, adaxially curved in bud; yellow aging to orange. *Perianth tube* 0,6—1,0 cm long, slightly laterally compressed, glabrous proximally, puberulous distally. *Perianth claws* becoming adaxially coiled on opening, covered with a fine indumentum of short crisped hairs interspersed with long, patent to erect, silky trichomes. *Style* 3,8—5,5 cm long, slightly adaxially curved, yellow aging to orange. *Pollen presenter* broadly conic to conic acute, 1,5—4,0 mm long, up to 2,0 mm broad, stigmatic groove terminal. *Hypogynous scales* deltoid-subulate 1,0 mm long.

Diagnostic Characters: In the field, *L. cuneiforme* may be recognised as a shrub with numerous stems arising from a large, woody, persistent rootstock; the basal stems being covered with warts and pustules. The narrowly cylindric involucral receptacle, glabrous to glabrescent cuneate leaves and the conic acute pollen presenter, are further distinguishing characters.

There can be no certainty as to when *L. cuneiforme* was first encountered by the early explorers, but it is highly probable that the first recorded collection was made by Oldenland, the Dutch East India Company's master gardener at the Cape. In 1689 Isaq Schryver journeyed eastwards from Cape Town on an expedition to barter with the Inqua Hottentots. The expedition crossed the Outeniqua mountains in the vicinity of Attaqua's Kloof (near the present day Robinson Pass). Schryver records the event thus:

> 'Friday 28th January 1689. At sunrise we left the said river and took a most troublesome way amongst high mountains, the krantzes of which were covered with dense brushwood. Amongst this a "Kreupleboom" here and there showed itself".

The name Kreupleboom, although usually reserved for *L. cononocarpodendron*, would have been applied to any large, yellow or orange flowered *Leucospermum*, but here Schryver is clearly referring to *L. cuneiforme* which is still common at this locality today. The special significance of this expedition and the above quotation is that Schryver was accompanied by "den botanicus Oldenland". Even if Oldenland did not collect *L. cuneiforme* on this occasion, he could have obtained material at many places along the Langeberg. N. L. Burman acknowledges Oldenland as the collector of the plants described in his *Florae Capensis Prodromus* although his name does not appear on the type specimen at Geneva. (Rourke, 1967: 263). Of considerable interest is an apparent duplicate in Schreber's herbarium at Munich, labelled "Oldenland". Since this specimen is morphologically very similar to the Geneva specimen and apparently mounted on the same type of paper, I conclude that it is an isotype.

During the past two hundred years a number of taxonomically superfluous species have been established on variable characters such as leaf length, the toothing of the leaf apex and the size of the inflorescences. These must now be reduced to synonymy.

Distribution, Ecology and Biology: The most widespread species in the genus, *L. cuneiforme* extends from Greyton in the Caledon district along the southern and eastern Cape coastal belt and adjacent mountain ranges, to just beyond Qolora mouth in the Kentani district, Transkei.

No other species in the genus has such a wide ecological amplitude as *L. cuneiforme*. The range of climatic types within which it occurs varies from the

winter rainfall area to the summer rainfall area and to areas where precipitation is evenly spread throughout the year. Its distribution range encompasses a broad spectrum of veld types ranging from climax sclerophyll on the south slopes of Langeberg composed mainly of Restionaceae, Ericaceae, Rutaceae and Proteaceae, to grassveld and the subtropical coastal dune forest of the eastern Cape (Acocks, 1953: 27–29) where I have observed it growing in association with *Phoenix reclinata* and *Stangeria eriopus*. It is also found in such diverse veld types as Arid Fynbos, in marginal areas fringing the Little Karroo and in the moist climax sclerophyll on the margins of the cool temperate evergreen forests in the Knysna–Tsitsikama area.

Despite this diversity, personal field observations and the records of others, indicate that *L. cuneiforme* is restricted to soils derived from Table Mountain Sandstone, Witteberg Quartzite or stabilised coastal sand of Tertiary origin. Populations are found from sea level to 3,500 ft.

L. cuneiforme is probably the most fire resistant species in the genus. Frequent burning keeps the shrubs low (5,5—1,0 m) and with multiple stems sprouting from a massive woody rootstock. If left unburnt for a number of years, a single main stem becomes dominant and an arborescent growth habit to 3,0 m is developed, but this is seldom observed due to the frequency of veld burning in its habitats.

Flowering can take place at any time of the year but mainly occurs between August and February.

Specimens Examined:

CAPE

CALEDON: Tygerhoek, Dec., *H. C. Taylor* 4486 (PRE, STE); South foot of Riversonderend mts., near Greyton, Nov., *Esterhuysen* 20810 (BOL); The Oaks, Genadendal, Oct., 1846, *Alexander Prior* s.n. (K); Tygerhoek, Feb., *Vogts* 66 (PRE, STE); Riversonderend, Oct., *Schlechter* 5645 (Z); In montibus Riversonderend, *Zeyher* 3681 (SAM, BOL, Z).

BREDASDORP: Cape Infanta, San Sebastian estate, west of Breede River mouth, Oct., *Rourke* 18 (BOL); Hamerkop, Potteberg range, Oct., *Levyns* 8422 (CT); In monte Potteberg, Oct., *Ecklon* and *Zeyher* s.n. sub. SAM 13375 (SAM); Potteberg, middle south slope, Oct., *Pillans* 9340 (BOL, PRE, K); Potteberg farm, north end of Potteberg Range, Oct., *Rourke* 950 (NBG); Potteberg flats, Nov., *Barker* 8453 (NBG); Grasrug, Cape Infante, Dec., *Rourke* 279 (NBG).

ROBERTSON: Langeberg at Cogman's Kloof, east side, Oct., *Esterhuysen* 32037 (BOL).

SWELLENDAM: On a mountain peak near Swellendam, Jan. 16th 1815, *Burchell* 7376 (K); Elevated dry places, *Niven* 49 (K); Tradouwsberg, *Bowie* s.n. (BM); At base of the Crown mountain, Aug., *Wurts* 278 (NBG); Marloth reserve, Sept. *Wurts* 369, 370 (NBG); Grootvadersbosch, Dec., *Lewis* 5337 (NBG); Rocky Kloof between Stormsvlei and Bonnievale, Sept., *Acock* 1738 (S); Mountain at Voormansbosch, Oct., *Pappe* s.n. sub SAM 19648 (SAM); Stormsvlei Kloof, Oct., *Rourke* 643 (NBG); Bontebok Park, Sept., *Liebenberg* 6475 (PRE, STE); Stoney hills, Buffelsjachts river, *Zeyher* 3682 (NY, PRE, B, SAM, K); Common everywhere, Swellendam, *Niven* s.n. (PH); Tradouw Pass, Sept., *Williams* 515 (BOL); In montibus Swellen-

dam, Oct., *Pappe* s.n. sub. SAM 19642 (SAM); Tradouw Pass, Sept., *Compton* 3406 (BOL); Open Veld near Swellendam, Oct., *Levyns* 720 (CT); Rocky, elevated places, Swellendam, *Niven* s.n. (K).

RIVERSDALE: In colle saxoso ad viam inter Garcia's Pass et Muiskraal, Oct., *Bolus* 11365 (BOL, NH, BR, PRE, Z); South of Herbertsdale, Feb., *Barker* 8526 (NBG); Garcia's Pass, Sept., *Phillips* 500 (SAM, PRE); Between Gouritz river and Waterval, April, *Middlemost* 2023 (NBG); Garcia's Pass, north slopes, Jan., *Rourke* 251 (NBG); Albertinia, Oct., *Compton* 7621 (NBG); At farm Waterval, Jan.. *Rourke* 249 (NBG); Paardeberg, Dec., *Muir* 5308 (PRE); Rietvlei, beyond Waterval, Sept., *Williams* 1056 (NBG).

OUDTSHOORN: Swartberg, lower slopes, May, *Pocock* S 165 (STE, PRE); Cango East, Oct., *Deas* s.n. sub SAM 5143 (SAM); North side of Outeniqua mountains near Moeras River, Dec., *Esterhuysen* 19484 (BOL); Swartberg Pass, May, *Compton* 7150 (NBG); Prince Albert, Quartzite mts., Oct., *Schimper* s.n. (Z); Swartberg Pass, Nov., *Hutchinson* 1151 (BOL, BM, K).

MOSSEL BAY: In arenoso prope Mossel Bay, Oct., *Schlechter* 5724 (Z); Pinegrove, Oct., *McDonald* 272 (BOL); South end of Robinson Pass, Sept., *Garside* 4799 (K); Between Herbertsdale and Langeberg, Dec., *Hall* 859 (NBG); Robinson Pass, Dec., Compton 23064 (NBG).

GEORGE: Goukamma, Dec., *Martin* 24 (BOL, NBG); Hills in Langkloof, George, Nov. 1847, *Alexander Prior* s.n. (K); Outeniqua Pass, Nov., *Werdermann* and *Oberdieck* 856 (PRE); Jonkersberg, Nov., *Compton* 21802 (NBG); Mountains in the district of George, *Bowie* s.n. (BM); Duivels Kop Pass, north slopes of Outeniqua mts., June, *Rourke* 466 (NBG).

KNYSNA: Between Knysna River forest and Goukamma River, Aug., *Burchell* 5563 (K); Tzitzikamma, Jan., *Liebenberg* 7811 (PRE); Witte Els Bos, July, *Fourcade* 790 (PRE); Phanton Pass, Nov., *Oldevig-Roberts* 209 (S); Road to Reenendal, Dec., *Middlemost* 2053 (NBG); Noetzie, Sept., *Middlemost* 1969 (NBG); Brenton on Sea, Aug., *Denman* 21 (NBG); Natures Valley, near Bloukrans Pass, Sept., *Rourke* 850 (NBG); Paardekop, Nov., *Steyn* 718 (NBG); Goukamma, Oct., *Compton* 7546 (NBG); Belvidere, Knysna, Jan., *A. V. Duthie* s.n. sub. STE 10377 (STE); Top of Prince Alfred's Pass, *Schonland* 3415 (GRA); Assegai Bos on slope towards Kromme River, *Schonland* 3073 (GRA, PRE); Hills north of Ruigte Vlei, July, *Levyns* 7806 (CT); Sedgefield, July, *Levyns* 10315 (CT); Coldstream, Sept., *Rodin* 1296 (BOL, PRE, K); Plettenberg bay Sept., *Rogers* 15437 (Z).

UNIONDALE: Kamanassie mountains, Jan., *Stokoe* s.n. sub. SAM 54381 (SAM); Kouga mts., at Braam River near Joubertina, Oct., *Esterhuysen* 16338 (BOL); Louterwater, dry hills, south slopes, Dec., *Compton* 4495 (BOL); De Hoek, north foot of Tzitzikamma mts. near Joubertina, March, *Esterhuysen* 22794 (BOL); Prince Alfred's Pass, Nov., *Acocks* 19950 (K, PRE); Four miles North by West of Joubertina mountain, Nov., *Acocks* 20018 (K, PRE); Helpmekaar Peak, Jan., *Esterhuysen* 4596 (BOL); Kareedouw, Nov., *Gillet* 2034 (K); Harlem, April, *Thode* A 2457 (PRE); Half a mile beyond the farm Bo Kouga, Sept., *Rourke* 891 (NBG).

WILLOWMORE: Baviaanskloof, Jan., *Gill* 22 (BOL); Baviaanskloof, Oct., *Esterhuysen* 25007 (BOL); Top of mountains at Baviaanskloof, Dec., *Theron* 1809 (K, PRE); Towards the south end of Baviaanskloof, Jan., *Gill* 1 (NBG).

STEYTLERVILLE: Mountains in the Steytlerville district, Oct., *Malherbe* 1159 (PRE).

HUMANSDORP: Guerna Kop, Oct., *Rourke* 616 (NBG); Zuuranys, Oct., *Rycroft* 2330 (NBG); Pisgoedvlakte, Sept., *H. C. Taylor* 913 (NBG); Near Assegaibos, May, *Wurts* 2082 (NBG); Between Humansdorp and Clarkson, Nov., *Middlemost* 1789 (NBG); West of Humansdorp, Nov., *Barker* 6888 (NBG); Loerie Plantation, Oct., *Dix* 62 (GRA); Longmore forest, Sept., *Long* 1044 (GRA, K, PRE); West of Humansdorp, Sept., *Sidey* 1721 (S); 17½ miles west of Humansdorp, Oct., *Acocks* 15379 (PRE); Kromme River, 4 miles west of Company's drift, Aug., *Fourcade* 2321 (K).

PORT ELIZABETH: Between Port Elizabeth and Bethelsdorp, Oct., *Zeyher* 748 (STE, SAM); Flats near van Stadens River mts., *Zeyher* 380 (PRE, STE, SAM, BOL, NH); Mountainside at Elands River, June, *Urton* 288 (GRA); On the hills near Port Elizabeth, Oct. and

Dec. *Zeyher* 3680 (SAM, PRE, Z, S); Near Port Elizabeth on road to Sea View, Aug., *Rodin* 1000 (BOL, PRE, K); Port Elizabeth, Nov.—March, *Laidley* 185 (Z); Between Uitenhage and Algoa Bay, *Burchell* 4275 (K); Round Krakamamana, 2nd Feb. 1814, *Burchell* 4529 (K); Algoa Bay, *Cooper* 1583 (K); Thescomb station, 8 miles west of Walmer, Sept., *Story* 2731 (PRE); Common in veld at Port Elizabeth, Jan., *Theron* 572 (PRE); Vaal Vlei estate, May, *Mogg* 4720 (PRE); Van Stadensberg, 28/12/1829, *Drège* s.n. (P).

UITENHAGE: Winterhoek mts., Jan., *Beard* 765 (NU); Great Winterhoek, Cockscomb mts., March, *Esterhuysen* 27158 (BOL, PRE); Galgebosch, Uitenhage *Dr. Pappe* s.n. (K); Enon, Nov., *Thode* A 1123 (NH, PRE, K); Uitenhage, 13 Dec. 1847, *Alexander Prior* s.n. (K).

ALEXANDRIA: Near Alexandria, Jan., *Leighton* 3143 (BOL); Between Alexandria and Alex Forest, Dec., *Johnson* 841 (PRE, K, G); Alexandria, dominant in valley south of village, April, *Galpin* 10639 (PRE).

ALBANY: Howison's Poort, *MacOwan* 62 (NY, NH, Z); Near Heatherton Towers, April, *Dyer* 1393 (PRE, GRA); Mountainside near Grahamstown, Sept., *Galpin* 54 (GRA, PRE); In clivis montis prope Howison's Poort, June, *MacOwan* 778 (BOL, BM, PRE, G, K); Highlands, Grahamstown, Sept., *Rogers* 27360 (K); Howison's Poort, Nov., *Hutchinson* 1522 (BOL, BM, PRE); On the Grahamstown–Port Elizabeth rd., Dec., *Barker* 599 (NBG); Highlands near Grahamstown, Oct., *Sidey* 1236 (S); Albany, Feb. 1848, *Alexander Prior* s.n. (K).

BATHURST: Coastal flats, Bathurst, Jan., *Sidey* 3409 (NY); Near juncture of Kop and Fish River mouth near Clumbers, Jan., *Dyer* 3392 (PRE); Elephant Park, Trappes Valley, Oct., *Sidey* 1915 (PRE, S); Bathurst, Aug., *Tyson* 19228 (PRE); Rocky slopes near Bathurst, Oct., *Tyson* 2959 (PRE); Delamere Farm, Dec., *Barker* 10500 (NBG); Sea View farm, Kleinemonde, Dec., *Barker* 10497 (NBG).

SOMERSET EAST; Zuurberg above Ann's Villa, Oct., *Acocks* 12024 (PRE, NBG); Komma dagga, Aug., *Bayliss* 1590 (Z, PRE); Top of Zuurberg Pass, Nov., *Rycroft* 2979 (NBG); Zuurberg Pass, Nov., *Compton* 20290 (NBG); Zuurbergen, 30/10/1829, *Drège* s.n. (P).

KOMGA: Grassy flats near Kei mouth, Jan., *Flanagan* 488 (GRA, Z, PRE, SAM).

KENTANI: Veld above Qolora river, Dec., *Alice Pegler* 714 (NU, GRA, BOL, PRE); Qolora, open veld on golf course, Feb., *Chippendall* 337 (PRE); Seagulls, Qolora mouth, on golf course, Sept., *Rourke* 845 (NBG).

WITHOUT PRECISE LOCALITY: Cape of Good Hope, *Verreaux* s.n. (NY, FI, G); E. cap b. spei, *Thunberg* s.n. in herb. Bergius (SBT); *Thunberg* s.n., no. 2915 in herb. Thunberg (UPS); *Thunberg* s.n. in herb. Montinii (S).

(3) **Leucospermum innovans** Rourke, sp. nov.

L. cuneiforme (Burm. f.) Rourke affinis propter caudice persistenti et receptaculo involucralis cylindraceo. Frutex caulibus rectis gracilibus, foliis perlate obovatis, multidentatis, et tubo perianthii distali ventricoso. Crescit in graminosis collibus, plerumque inter rupes saxum arenaceum montis tubularis.

Frutex erectus, rotundatus, ad 1 m in diam. *Caules* plurimi, recti et graciles, a caudice lignoso persistenti exorienti. *Folia* glabri, perlate obovati a latissime cuneati (3,0—5,0 cm lati, 7,0—10 cm longi). Lamina basi in petiolum puberulum distinguibem gradatim decrescens. Apex folii subtruncatus ad rotundatus, 5–10 dentatus. *Inflorescentia* globosa (8,0—9,0 cm in diam.), plerumque singulare. Receptaculum involucrali cylindraceum, 3 cm longum, 1 cm latum.





FIGS. 8 AND 9.
(8) Distribution of *Leucospermum cuneiforme* (Burm. f.) Rourke.—(9) Distribution of *Leucospermum innovans* Rourke.

Bracteae late ovatae acutae, imbricatae, cartilaginiae, velutinae. *Tubus perianthii* 10,0—12,0 mm longus, ventricosus in dimidium distale. *Segmentum perianthii* dense villosum sed trichomatibus longis (3,0—5,0 mm) rectis interspersum. *Limbi perianthii* peranguste elliptici (5,0 mm longi). Limbus adaxialis minus pilosus. Limbi tres abaxiale pilosi. *Stylus* 5,0 cm longus arcuatus, ad apciem versus decrescens. *Stigma* conica acuta, 1 mm longa.

An erect, rounded shrub to 1,0 m in diam. Stems arising from a woody persistent rootstock, up to 30,0 cm in diam. *Flowering stems* very straight, erect and slender, 5,0 mm in diam., covered with a dense indumentum of fine crisped hairs, interspersed with numerous long (3,0—4,0 mm) straight hairs. *Leaves* obovate, very broadly cuneate to cuneate, 7,0—10,0 cm long, 3,0—5,0 cm broad, narrowing to a distinct petiolar region; apex rounded to truncate, with 5 to 10 teeth, occasionally deeply incised; glabrous but with a dense crisped indumentum in the petiolar region. *Inflorescences* globose, 8,0—9,0 cm in diam., sessile or pedunculate, peduncle to 1,5 cm long. *Involucral receptacle* cylindric 3,0 cm long, 1,0 cm wide. *Involucral bracts* broadly ovate acute, imbricate, cartilaginuous 1,0 cm long, 0,8 cm wide; outer surface densely velutinous, apex cinereous. *Bracteoles* ovate—obtrullate, acute, very densely lanate proximally, velutinous distally, softly cartilaginous; 7,0 mm long, 5,0 mm wide. *Perianth tube* 10,0—12,0 mm long, ventricose distally, becoming narrowed proximally, laterally compressed; 5,0 mm in diam. distally, 2,0 mm in diam. proximally; glabrous proximally becoming sparsely villous distally. *Perianth claws* covered with a dense villous indumentum interspersed with long (3,0—5,0 mm), straight hairs. *Perianth limbs* very narrowly lanceolate elliptic, 5,0 mm long, 1,5 mm wide, with a short, dense, villous indumentum, interspersed with long, straight trichomes. The adaxial limb less densely pubescent than the 3 abaxial limbs. *Style* 5,0 cm long, slightly adaxially arcuate tapering subterminally. *Pollen presenter* narrowly conic acute, 2,0 mm long, 1,0 mm wide; stigmatic groove terminal.

Diagnostic Characters: L. innovans is distinguished from *L. cuneiforme* by its very broadly cuneate to obovate leaves, with 7–10 teeth at the apex, and by the perianth tube, ventricose distally but becoming narrowed proximally. The erect, very slender (5,0 mm in diam.) stems are particularly characteristic of this species.

Type Material: Transkei, Lusikisiki district, between Fraser's Falls and Picnic Falls, about $\frac{1}{2}$ a mile east of the Ntusbane forest station, 4th Sept. 1967, *Rourke* 841 (holotype, NBG).

Mr. William Tyson made the first recorded collection of this species as early as October 1885. His material was determined as *L. attenuatum* R. Br. as were most subsequent collections of *L. innovans*.

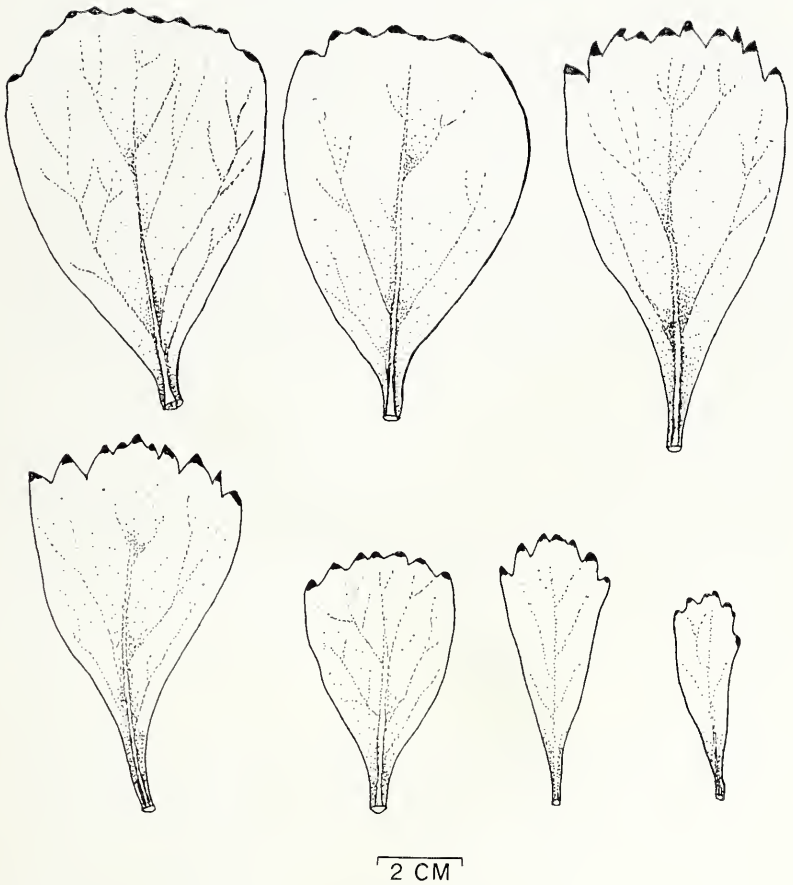


FIG. 10.
Leucospermum innovans Rourke, showing variation in the leaves from the type collection, *Rourke* 841.

Distribution, Ecology and Biology: According to our present information, *L. innovans* is confined to the subtropical coastal belt of the Eastern Cape and Natal, between Lusikisiki and Port Shepstone.

The entire distribution range falls within a veld type described as Pondoland Coastal Plateau Sourveld (Acocks, 1953), and receives a fairly high summer

rainfall of 45–50″ p.a. Most of the populations occur in close proximity to the sea, usually within about 3 miles of the coast. Small clumps of plants occur in open grassveld on the plateaux above the escarpment, always among the rocky outcrops of Table Mountain Sandstone. The close association between *L. innovans* and the rocks of the Table Mountain Sandstone series is one of its most marked ecological features.

L. innovans is a very fire resistant species. New shoots sprout rapidly from the woody underground rootstock soon after the aerial stems have been burnt off. Due to the repeated burning of the grassveld in which this species grows, some plants seldom reach more than 45,0 cm in height, but under favourable conditions the plants develop into rounded shrubs up to 1,0 m in height.

Inflorescences are produced rather erratically between July and December with the peak of the flowering season being in September and October.

Specimens Examined:

CAPE

LUSIKISIKI: Ntsubane forest station, Aug., *O. B. Miller* s.n. (PRE 2595, K); Midway between Umsikaba river and site of Grosvenor wreck, ½ mile from sea shore, July 1965, *W. L. Chiazzari* s.n. (NBG 80, 632, PRE 30375); Lusikisiki, Pondoland, Nov. 1934, *H. C. Bellew* s.n. (BOL); On stony koppie near mouth of the Msikaba river, north Pondoland, Sept. 1937, *H. C. Bellew* s.n. (PRE 30374, K); Egossa, Pondoland, Aug. 1899, *Sim* 2513 (BOL, PRE); Picnic falls near Fraser's falls, Nov., *Williams* 565 (BOL); Rocky outcrop in grassland at Mkambati Leper Institution, Aug., *Story* 4249 (PRE); Between Fraser's falls and Picnic falls, about ½ a mile east of Ntsubane forest station, Sept., *Rourke* 841 (NBG); Pondoland, Oct. 1885, *W. Tyson* 2612 (BOL).

NATAL

PORT SHEPSTONE: On the farm Excelsior, Paddock, mountain krantzes, Dec., *Strey* 6201 (NU, NH, PRE).

(4) **Leucospermum gerrardii** Stapf in Fl. Cap. **5:** 619 (1912); Burtt Davy, Fl. Transv. Pt. **1:** 211 (1926); Flower Pl. S. Afr. **17:** 668 (1937); Letty, Wild Flow. Transv.: 117–119 (1962); Compton in Jl S. Afr. Bot. Suppl. vol. **6:** 18, 20, 41, 106 (1966). Type: Natal, received July 1865, *W. T. Gerrard* 1664 (holotype, K).

A dwarf soboliferous shrub 20,0—40,0 cm in height, multiple stemmed at the base, with a subterranean rootstock from which arise numerous short, erect branches; forming dense mats up to 1,0 m in diam. *Flowering stems* slender, erect, 2,0—3,0 mm in diam., arachnoid at first becoming glabrous later. *Leaves* linear to oblanceolate, occasionally falcate, 5,0—9,0 cm long, 0,8—2,0 cm wide, narrowed to a distinct petiole at base; usually entire with an apiculate callous tip, occasionally 3 or 4 toothed; puberulous at first, soon glabrous; the veins very prominently raised on the leaf surface, reticulate to parallel. *Inflorescences* ovoid, 4,0—7,0 cm in diam.; pedunculate, peduncle 1,0—2,0 cm

long; inflorescences usually single, occasionally with up to 3 per flowering shoot. *Involucral receptacle* cylindric 1,5—2,5 cm long, 3.0—4,0 mm wide. *Involucral bracts* ovate-acuminate, 10,0 mm long, 5,0 mm wide, very densely tomentose, cartilaginous, 2–3 seriate. *Brácteoles* ovate-acuminate, 10,0 mm long, 3,0 mm wide, clasping the perianth; thickly lanate proximally, villous distally, cartilaginous. *Perianth* 3,0—3,5 cm long, yellow on opening becoming orange to scarlet. *Perianth claws* coiled subterminally on opening; the median adaxial claw puberulous, the lateral and abaxial claws thickly villous. *Perianth limbs* lanceolate-acute, 5,0 mm long, densely beset with long straight trichomes. *Anthers* sessile, 3,0 mm long, lanceolate acute. *Style* 5,0 cm long, tapering subterminally, slightly adaxially arcuate. *Pollen presenter* narrowly conical acute, 2,0—2,5 mm long, stigmatic groove terminal. *Hypogynous scales* subulate, 2,0 mm long.

Diagnostic Characters: The dwarf soboliferous growth habit and distinctive linear to oblanceolate, slightly falcate leaves with prominently raised venation, distinguish *L. gerrardii* from all other species with cylindric involucral receptacles.

W. T. Gerrard made the first recorded collection of this species, probably in 1865. He appears to have made two separate collections both of which are mounted on the type sheet. One specimen labelled "Natal" has leaves typical of material from Swaziland. The other, labelled "Natal—Zululand" has leaves typical of specimens from central Natal. As the measurements given by Stapf cover the entire range of this material it is clear that both specimens were used in the original description.

Distribution, Ecology and Biology: The main distribution area is in the high mountainous country of the Barberton and Carolina districts in the eastern Transvaal and the highlands of north-west Swaziland. Isolated and rather scattered populations occur in central Natal.

L. gerrardii possesses a stout, woody rootstock bearing numerous, spreading rhizome-like underground stems. Stiff, erect shoots, seldom exceeding 30 cm in height, develop from these stems, which causes the mature plants to have a dense cushion-like appearance. Grass fires regularly burn off the short aerial stems but new shoots regenerate from the underground stems and rootstock. *L. gerrardii* is one of the most fire resistant species in the genus.

In north-west Swaziland and in the Barberton area *L. gerrardii* occurs in open grassveld or in short montane grassveld among rocky outcrops of granite or quartzite at elevations varying from 4,000–6,000 ft. Mists are frequent in summer. Collections from Natal have been made at lower altitudes, generally 1,500–3,500 ft. in grassland on Ecca sandstone or Table Mountain sandstone.

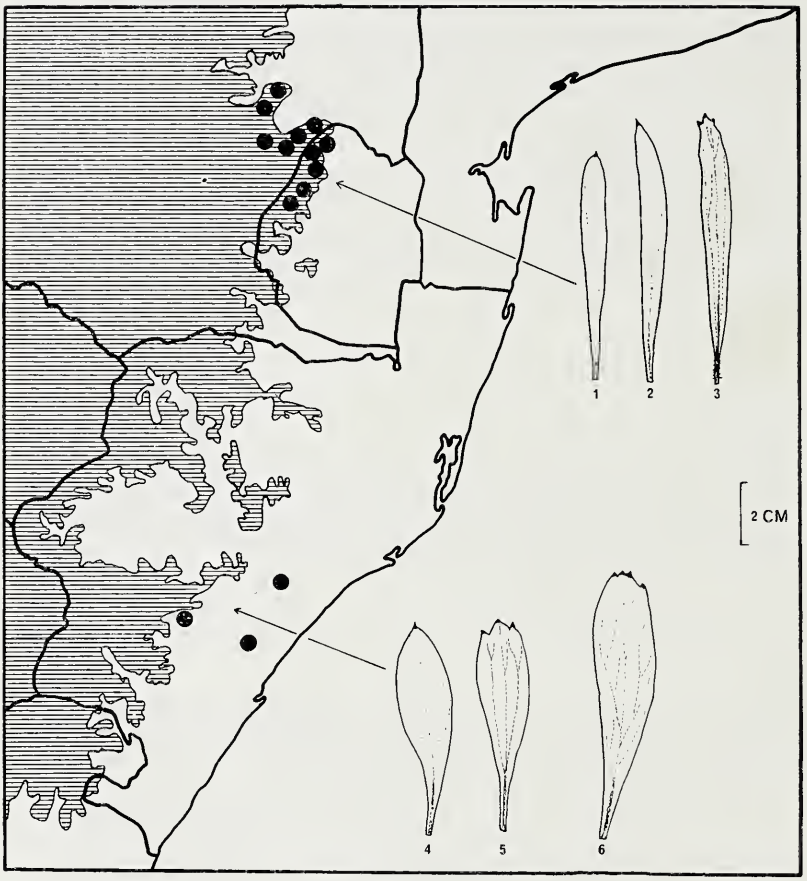


FIG. 11.

Distribution of *Leucospermum gerrardii* Stapf. Variation in the leaf dimensions of specimens from the two disjunct areas of distribution is shown. The hatched area represents land above 4 000 ft. (1) *Compton* 26103; (2) *Hamilton* s.n. no. 986 in herb. Beard; (3) *Dhlamini* s.n. NBG 28567; (4 & 5) *Hilliard* 874; (6) *Strey* 7530. 1, 2, and 3 are representative of the narrow leaved form from Swaziland and the eastern Transvaal; 4, 5 and 6 are representative of the generally broader leaved Natal form.

The summer rainfall in these areas may be up to 40″ p.a. and up to 60″ p.a. in higher lying regions. Flowering takes place erratically throughout the year but chiefly from September to November.

Variation: Material from the two main areas of distribution differs only in the dimensions of the leaves. Collections from Natal have mostly broader leaves than material from Swaziland and the Barberton area. As there is a complete gradation between the two extreme forms however, the recognition of sub-specific taxa is not considered advisable (fig. 11).

Specimens Examined:

NATAL

NDWEDWE: Zwati, on Table Mountain Sandstone in grassland, June, *Strey* 7530 (NH).

MAPUMULO: Fort Cross on road between Mapumulo and Kranskop, Sept., *Hilliard* 874 (NU).

NEW HANOVER/LIONS RIVER: On the farm Branxholme, Karkloof, Nov., *Beard* 987 (NU); Road from York to Rietvlei on the farm Branxholme, Karkloof, April, *Beard* 789 (PRE).

SWAZILAND

MBABANE: Waverly mine, Oct., *Compton* 26103 (NBG, K, PRE); Forbes Reef, Oct., *Thorncroft* 726 (NH).

PIGGS PEAK: Mountain tops at Havelock concession, Sept., *Saltemarshe* s.n., no. 1045 in herb. Galpin (SAM, BOL, PRE, GRA, NH, Z); Havelock mine, Sept., *Miller* 4519 (K, PRE, BR); Sept., *Miller* 2997 (PRE); Havelock, Oct. *Dhlamini* s.n. (NBG 28567).

TRANSVAAL

BARBERTON: Saddleback mountains, Nov., *Thorncroft* 1001 (BOL); Barberton, *Rogers* 24829 (STE, BOL, PRE, K); Mountains 20 miles N.E. of Barberton, Sept., *de Wet* s.n. (NBG 81915); Moodie near Barberton, Sept., *Thorncroft* 12 (NH); Nelshoogte, Nov., *Hamilton* s.n., no. 986 in herb. Beard (NU); Nelshoogte, Botha's Nek, March, *Meeuse* 10091 (PRE); 7 miles west of Barberton, Nov., *Feynolds* 3935 (PRE).

CAROLINA/BARBERTON: Nelsberg, Feb., *van der Merwe* 1643 (PRE); Summit of Nelsberg, Oct., *Reynolds* 2145 (PRE, K).

NELSPRUIT: Duivels Kantoor, Oct., *Thode* A1644 (NY, K, PRE, NH); Kaapsche Hoop, Oct., *Thode* s.n. (NH 20060); Near Kaapsche Hoop, Oct., *Schlieben* 8446 (PRE, K); Kaapsche Hoop, Oct., *Prosser* 1271 (K); Kaapsche Hoop, Dec., *Gilmore* 2338 (PRE, G).

Sect. 2. CONOCARPODENDRON Buek ex Endl.

Large shrubs or small trees to 4,0 m in height, with a single stout main trunk. Involucral receptacle conic to narrowly conic acute. Involucral bracts acuminate or acuminate recurved. Style 5,0—6,0 cm long, stout, 1,5—2,0 mm in diam. Pollen presenter conic acute.

Type: *L. conocarpodendron* (L.) Buek

There is considerable variation in the form and dimensions of the leaves in *L. conocarpodendron* and also in the number of teeth at the leaf apex (fig. 12). The majority of populations throughout its range have dark green, glabrous or glabrescent leaves. On the Cape Peninsula however, a series of populations occurs from the eastern slopes of Devils Peak along the western and northern slopes of Table Mountain, Lion's Head and the Twelve Apostles, to Llandudno. They are characterised by having canescent leaves covered with a dense indumentum of fine crisped hairs. Apart from being clearly delimited geographically, these populations grow mainly on decomposed Cape Granite in dry, exposed N.W. facing positions. The usual form with glabrous leaves occurs as far north as Kirstenbosch on the south eastern slopes of Table Mountain, but its range is not contiguous with that of the canescent leaved form due to the ecological barrier formed by the evergreen forests at Kirstenbosch and Newlands. The most southerly population of the form with canescent leaves is on Little Lion's Head, above Llandudno and is almost contiguous with the glabrous leaved form on the adjacent Karbonkelberg. A hybrid swarm between these forms occurs on the eastern slopes of Little Lion's Head above Mt. Rhodes. While the two parent populations are completely uniform as regards leaf pubescence, every intermediate can be found in the hybrid swarm.

Plants raised from seeds collected at Oudekraal (near Llandudno) and on the Karbonkelberg, have remained true to type after four years in cultivation, suggesting that the presence or absence of a crisped canescent indumentum is a genetically stabilised character. As the presence of a crisped canescent indumentum on the leaves is associated with populations from a geographically circumscribed area, it is proposed that two subspecific taxa in *L. conocarpodendron* be recognized, based on the presence or absence of this character.

(5) **Leucospermum conocarpodendron** (L.) Buek, Ind. Gen. et Spec. ad DC. Prodr. **4:** 203 (1874).

A large, rounded shrub or tree 3,0—5,0 m in height, 3,0—6,0 m in diam.; crown rounded, rigid due to the very divaricate interlocking branchlets; trunk stout, 15,0—40,0 cm in diam., covered with thick (3,0—5,0 cm) bark, greyish reddish or black with reticulate, horizontal or longitudinal fissures. *Flowering stems* stout and rigid, 1,0—1,5 cm in diam., covered with a short, dense, whitish to cinereous indumentum of crisped hairs or with a shaggy, villous indumentum of patent, silky trichomes. *Leaves* sessile, oblong, oblanceolate, broadly elliptic or obovate, 6,0—11,5 cm long, 2,5—5,0 cm wide; apex rounded or acute, obtusely or deeply incised with 3–10 teeth; glabrous, or pubescent with a fine greyish indumentum of short, crisped hairs, margins occasionally fimbriate. *Inflorescences* globose to ovoid, 7,0—9,0 cm in diam.; pedunculate, peduncle

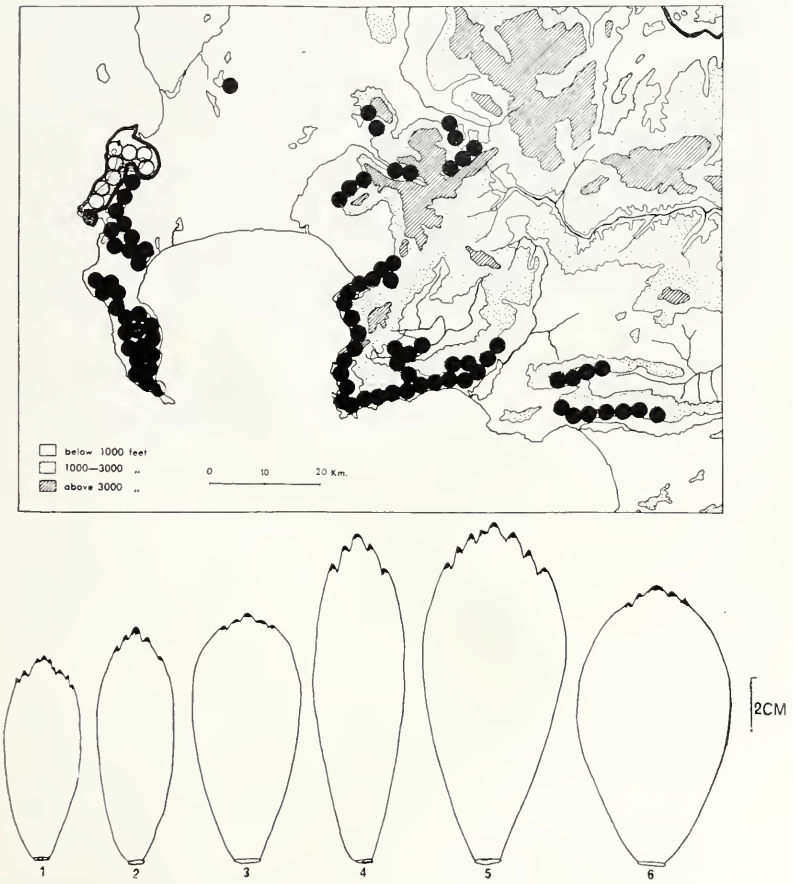


FIG. 12.
Distribution of *L. conocarpodendron* (L.) Buek ssp. *conocarpodendron* (open circles) and ssp. *viridum* Rourke (solid circles). The leaf outlines show the range of variation in the leaves (1) *Rourke* 939; (2) *Rourke* 1096; (3) *Rourke* 1021; (4) *Rourke* 57; (5) *Rourke* 926; (6) *Rourke* 684.

to 1,5 cm long; occasionally solitary but usually in groups of up to 3; often partly enclosed by the uppermost leaves on the shoot. *Involucral receptacle* conic acute, 2,5—3,0 cm long, 1,0—1,5 cm wide. *Involucral bracts* ovate acuminate, 1,2—1,5 cm long, 1,0 cm wide, tightly imbricate, cartilaginous, villous to tomentose. *Bracteoles* obtrullate, apex sharply acuminate, 2,0 cm long, 1,0 cm wide, cartilaginous, clasping perianth; lanate proximally, sericeous distally. *Perianth* 3,5—5,0 cm long, yellow. *Perianth tube* 1,0 cm long, cylindric, glabrous. *Perianth claws* recurved at anthesis, beset with an erect sericeous to very densely sericeous indumentum, except the median adaxial claw which is puberulous to shortly villous. *Perianth limbs* lanceolate acute, 6,0—8,0 mm long; outer surface closely adpressed sericeous, the median adaxial limb puberulous. *Style* stout, 1,0—1,5 mm in diam., 4,5—5,5 cm long, adaxially curved at first, later straightening. *Pollen presenter* broadly conic acute, 4,0—5,0 mm long, 2,0 mm wide. *Hypogynous scales* lanceolate acute, 2,0 mm long.

Diagnostic Characters: *L. conocarpodendron* is distinguished from related taxa by its arborescent growth habit, conic acute involucral receptacle, ovate acuminate involucral bracts and the broadly conic pollen presenter.

Key to the subspecies

Leaves canescent, with a dense indumentum of fine crisped hairs ssp. *conocarpodendron*

Leaves deep green, glabrous or glabrescent (margins occasionally fimbriate). ssp. *viridum*

(*a*) ssp. **conocarpodendron**

Leucadendron conocarpodendron L., Sp. Pl. ed 1: 93 (1753). Lectotype: Boerh., Ind. Plant. Hort. Lugd. Bat. **(2):** 196 t.196 (1720).
Protea conocarpodendron (L.) Reichard, Syst. Plant. **1:** 271 (1779).
Protea conocarpa Thunb., Diss. Prot.: 22, 47, 48 (1781), —nom. supfl.
Leucospermum conocarpum (Thunb.) R.Br. in Trans. Linn. Soc. Lond. **10:** 99 (1810); Phillips & Stapf in Fl. Cap. **5:** 616 (1912); Adamson and Salter, Fl. Cape Penins.: 326 (1950).
Protea tortuosa Salisb., Prod. Stirp. Hort. Chapel Allerton: 48 (1796), —nom. supfl.
Leucadendrum crassicaule Salisb. ex Knight in Knight, Cult. Prot.: 55 (1809), —nom. supfl.
Leucospermum macowanii Gandoger in Bull. Soc. bot. Fr. **48:** 94 (1901). Type: In rupestribus ad latera Montis Diaboli, Oct., *MacOwan* 774, holotype in herb. Gandoger (LY); isotypes (BOL, K, BM, G).

Pre Linnaean Citations.

Salix conophora Africana lato obtuso crenato folio lanuginoso. *Herm., Parad. Bat. Prodr. : 372 (1689).*

Leucadendro similis Africana arbor argentea folio summo crenaturis florida. *Pluk., Phyt. (Pars 3) t. 200 f.2 (1692).*

Conophorus Cap. B. S. folio in summo dentato. *Petiver, Musei Petiveriani : 22 (1695).*

Leucadendros Africana arbor argentea, summo folio crenato—a Promontor. Bon. Spei sibi allatum ad me missit Vir D. Patricus Adair. *Pluk., Opera 2 (Almagest.) : 212 (1696).*

S colymocephalus Africanus, latifolius, lanuginosus, foliis in summitate crenatis, coma sericea. D. Sherrard. Pinus africana latifolia, lanuginosa foliis in summo crenatis. D. Herman. *In Ray, Hist. Plant. tom. 3 Dendr. : 9 (1704).*

Conocarpodendron; folio crasso, nervoso, lanuginoso, supra crenato, ibique limbo rubro; flore aureo cono facile deciduo. *Boerh., Ind. Plant. Hort. Lugd. Bat. (2) : t. 196 (1720).*

Protea foliis oblongo—ovatis, apice quinquedentato callosis. *Royen, Fl. Leyd. Prod. Plant. Hort. Acad. Lugd. Bat. : 184 (1740).*

Flowering stems pubescent, with a shaggy villous indumentum of patent trichomes. Leaves canescent, beset with a dense indumentum of fine crisped hairs, only becoming glabrescent after several years.

Only two of the six polynomials cited by Linnaeus in his original description of *L. conocarpodendron* are accompanied by illustrations. As he had no herbarium material of this species, the description was evidently based on one of these illustrations. Plukenet depicts a single detached leaf with nine teeth at the apex while in Boerhaave's plate, a complete flowering branch is illustrated in which the leaves generally have five teeth at the apex. The latter plate is therefore most likely to have been the source of the word "quinquedintatis" used by Linnaeus in the phrase name of *L. conocarpodendron*. Consequently, it is suggested that Boerhaave's plate serve as the lectotype of this name. It is also clear that since Boerhaave uses the phrase "folio . . . lanuginoso", he was referring to the form from Table Mountain with canescent leaves.

Distribution and Ecology: The typical subspecies is endemic to the Cape Peninsula where it occurs over a limited area, ranging from the eastern slopes of Devils Peak along the northern and western slopes of Table Mountain and the Twelve Apostles, to Llandudno.

It occurs mainly on heavy clay derived from decomposed Cape Granite but also grows on Table Mountain Sandstone at a few places. Well drained, north or west facing slopes are the most favoured habitat. The mature plants are fairly fire resistant probably due to the thick bark (3,0—5,0 cm) on the trunk and main stems. Regeneration takes place from the apical branchlets, while

the lowermost stems are burnt off. Frequent burning causes the adult trees to develop an umbrella shaped growth habit. (Luckhoff, 1951: t. 68). Flowering takes place from August to December.

Specimens Examined.

CAPE

CAPE: Camps Bay, Jan., *Young* s.n. sub. 26603 in herb. Tvl. Mus. (PRE); Table Mtn., Sept., *Muir* 727 (PRE); Cape, *Verreaux* s.n. (G); Cape, *Sonnerat* s.n. cat. no. 4100 in herb. Jussieu (P-JU); Table Mtn. 13/10/1827, *Drège* 187a (P); Bakoven, Sept., *Hafstrom & Lindeberg* s.n. (S); Salt River, *Wahlberg* s.n. (S); Table Mtn., Jan., *Rogers* 3001 (GRA); Devils Peak, Jan., *Wolley Dod* 570 (BM); Lower parts of Table Mtn., *Bowie* s.n. (BM); Devils Peak, Oct., *MacOwan* no. 774 in Herb. Norm. (BOL, LY, K, BM, G); Lions Head, 12/1/1894, *O. Kuntze* s.n. (NY, Z, K); Table Mtn., Oct., *Bolus* 2909 (K); Lions Head, Sept., *Ecklon* s.n. (K, B, G, M); Lions Head, *Pappe* s.n. (SAM); Table Mtn., near Mowbray, 10/1/1894, *O. Kuntze* s.n. (NY, K); Cape Town, *Rehmann* 2072, 2073 (Z); Table Mtn., *MacGillivray* 640 (K, PRE); Rondebosch, Oct., *Slade* s.n. (PRE); Little Lions Head above Llandudno, Oct., *Rourke* 924 (NBG); Devils Peak forest station, Sept., *Rourke* 1121 (NBG); Oudekraal, Oct., *Rourke* 923 (NBG); U.C.T. grounds, Nov., *Esterhuysen* 26469 (BOL).

(*b*) ssp. **viridum** Rourke, ssp. nov.

A subspecie typica differt, foliis glabris atrovirentibus, destitutis indumentis crispis canescentibus.

Flowering stems generally pubescent with a dense indumentum of fine crisped hairs, rarely with shaggy, villous, patent trichomes. Leaves glabrous, bright green in live state, very rarely with a few scattered, straight trichomes but never with a fine crisped indumentum.
ICON: Flower. Pl. S. Afr. **17**: 667 (1937).

Type Material: Between Sunny Seas and De Wet's Bay, near mouth of Palmiet River, 19th Nov. 1968, *Rourke* 1168 (holotype, NBG).

Distribution and Ecology: L. conocarpodendron ssp. *viridum* occurs on the Cape Peninsula between Kirstenbosch and Karbonkelberg in the north, and Cape Point. Off the Cape Peninsula it occurs in the upper Berg River Valley, at French Hoek, Jonkershoek, Sir Lowry's Pass and southwards to Cape Hangklip and Hermanus, extending along Shaws Mountain and along the Klein River Mountains as far as Stanford. Relict populations still survive in the foothills of the Helderberg and Simonsberg and on Kanonberg at Durbanville.

It grows in a wide variety of habitats: stabilised sand dunes near the sea, permanently moist peaty sponges, stony Table Mountain Sandstone slopes, Malmesbury gravel and in a few places on decomposed Cape Granite. Most populations are found at relatively low altitudes, from sea level to 500 ft. and

very rarely occur above 1,000 ft. At some localities it becomes dominant with very dense stands developing. Like the typical subspecies it is fairly fire resistant. Flowering takes place from August to January.

Specimens Examined:

CAPE

WYNBERG: Castle Buttress, Sept., *Rourke* 588 (NBG); Karbonkelberg, Oct., *Rourke* 926 (NBG); Wynberg, *Wallich* s.n. (BM); Wynberg Hill, Aug., *Salter* 9253 (BM); Wynberg Hill, Aug., *Bolus* 2909 (BOL, K); S.E. of Table Mtn., Sept., *Werdermann & Oberdieck* 121 (PRE); Wynberg Hill, July, *Gamble* 22101 (K); Hillside at Kirstenbosch, Oct., *Forbes* 158 (NH).

SIMONSTOWN: Muizenberg Mtn., Dec., *Noel* 426 (GRA); Simon's Bay, Oct., 1801, *R. Brown* s.n. (BM); Simonstown, Nov., *Meebold* 12419 (NY); Silvermine, Sept., *Werdermann & Oberdieck* 127 (K); Fish Hoek, Dec., *Young* 250 (PRE); Muizenberg mts., Oct., *Lansdell* s.n. (PRE); Silvermine Valley, Aug., *Rourke* 1088 (NBG); Klaasjagersberg, Nov., *Rourke* 684 (NBG); Between Rooikrans and Cape of Good Hope, Sept., *Rourke* 1122 (NBG).

BELLVILLE: Kanonberg, 2 miles N.W. of Durbanville, Oct., *Rourke* 939 (NBG).

STELLENBOSCH: Bloem Erf, *Stanford* s.n. (BOL); Klapmuts, Dec., *van der Bijl* s.n. sub NH 16165 (NH); Jonkershoek, above Swartbrug, Dec., *Kruger* 787 (NBG); Stellenboschberg, Sept., *Strey* 484 (PRE); Jonkershoek, Oct., *Garside* 202 (K).

PAARL: Roadside near French Hoek, Nov., *Letty* 55 (PRE); French Hoek, Oct., *Phillips* 1267 (SAM); Slopes above French Hoek, Sept., *Rourke* 585 (NBG).

SOMERSET WEST: Gordon's Bay mtns., Nov., *Nel* s.n. sub STE 13105 (STE); Sir Lowry's Pass, Dec., *Rourke* 59 (BOL); Sir Lowry's Pass, Oct., *Schlechter* 5367 (Z); Helderberg, lower N.W. slopes, Sept., *Rourke* 1096 (NBG); Foot of Sir Lowry's Pass, *Barker* 8806 (NBG); Summit of Sir Lowry's Pass, Nov., *Rourke* 962 (NBG).

CALEDON: Ridge above Zandfontein, Oct., *Galpin* 4462 (K, PRE); Between Gordon's Bay and Betty's Bay, Oct., *Dyer* 5762 (PRE); Between Bot River and Kleinmond, June, *Cheadle* 826 (PRE); Caledon, Oct., *Marloth* 8923 (PRE); At Hangklip, Jan., *Rodin* 3140 (BOL, K); Hermanus, Jan., *Burtt Davy* 18494 (BOL); Between Aries Kraal & Louws River drift, Kogelberg Reserve, Dec., *Rourke* 1001 (NBG); Ysterklip, between Bot River and Kleinmond, Sept., *Rourke* 917 (NBG); Mossel River, Nov., *Barker* 8504 (NBG); N. of Rooi Els, Jan., *Gill* 7 (NBG); Between Sunny Seas and De Wet's Bay, Nov., *Rourke* 1168 (NBG); Stoff Vlei, above Hermanus Yacht Club, Oct., *Rourke* 1144 (NBG); Between Betty's Bay and Palmiet River mouth, Dec., *Rourke* 1021 (NBG); Pringle Bay, near Cape Hangklip, Jan., *Rourke* 1023 (NBG).

WITHOUT PRECISE LOCALITY: Comm. Mrs. *Phillips*, *Letty* 377, figured for Flower. Pl. S. Afr. (PRE).

HYBRIDS: Little Lions Head, S.E. of Mt. Rhodes, Cape Peninsula, Oct., *Rourke* 925 (NBG). This collection is a representative sample of the hybrid swarm between the two subspecies, occurring on Little Lions Head.

(6) **Leucospermum glabrum** Phillips in Kew Bull. **1910:** 331 (1910); in Fl. Cap. **5:** 617 (1912); in Flower. Pl. S. Afr. **8:** t. 311 (1928). Type: Forest near Touw River, George, 20th Aug. 1814, *Burchell* 5726 (Lectotype, K; BOL, NY, B, M).

An erect, rounded shrub to 2,5 m in height, with a single main stem at base, trunk to 10,0 cm in diam., bark reddish brown. *Flowering stems* erect, woody,

5,0—10,0 cm in diam., pilose at first, soon glabrous. *Leaves* subsessile, loosely ascending, obovate to very broadly obovate, cuneate at base, 8,0—12,0 cm long, 3,0—5,0 cm broad; glabrous, bright green in live state, with 7–14 teeth at apex. *Inflorescences* ovoid, 7,0—9,0 cm in diam., subsessile, usually solitary occasionally 2–3 nate. *Involucral receptacle* conic, 4,5 cm long, 1,3 cm wide. *Involucral bracts* ovate, 9,0 mm long, 6,0 mm wide, with a recurved acuminate apex; tightly adpressed imbricate, cartilaginous, tomentose. *Bracteoles* obtrullate, 1,5 cm long, 1,0 cm wide, apex caudate-acuminate, strongly recurved, margins ciliate, adaxial surface deep carmine in fresh state; cartilaginous, densely lanate proximally tomentose distally. *Perianth* 3,5 cm long, bright orange to carmine. *Perianth tube* 10,0 mm long, glabrous. *Perianth claws* bright crimson on inner surface; the abaxial claw sparsely villous, the three adaxial claws set with a dense, short indumentum of crisped hairs. *Perianth limbs* narrowly elliptic, acute, abaxial limb densely villous, the 3 adaxial claws sparsely villous. *Style* 5,0—6,0 cm long, stout (2,0—3,0 mm in diam.), slightly arcuate adaxially. *Pollen presenter* conic, acute 6,0 mm long, 3,0 mm wide, stigmatic groove terminal. *Hypogynous scales* deltoid 1,5 mm long, ivory to cream.

Diagnostic Characters: L. glabrum is distinguished by its large (8,0—12,0 × 3,0—5,0 cm) obovate, bright green, glabrous leaves with 7–14 teeth at the apex, the glabrous mature stems and the acuminate-recurved involucral bracts.

Distribution and Ecology: Populations of *L. glabrum* occur sporadically along the southern foothills of the Outeniqua mountains, from Cradockberg above George, eastwards to the Plettenberg Bay—Prince Alfred's Pass area.

This species appears to be restricted to cool, sheltered, south facing slopes at elevations of 500 to 1 500 ft. The mean annual rainfall of 30—40″ p.a. is distributed more or less evenly throughout the year. *L. glabrum* grows on permanently moist peaty soils in a very tall, dense type of fynbos termed "hygrophilous macchia" (Phillips, 1931: 112), generally in association with *Berzelia spp.*, *Leucadendron spp.*, *Erica spp.* and *Laurophyllus capensis*. Flowering takes place from August to October.

Specimens Examined:

CAPE

GEORGE: Forest near the Touw River, 20th Aug. 1814, *Burchell* 5726 (K, M, B, BOL, NY); George mountain, Aug., *Gie* s.n. sub. STE 16872 (STE); Woods near George Town, Sept. 1847, *Alexander Prior* s.n. (K, PRE); Touw River, Sept., *Fourcade* s.n. (K); Between Cape Town & George Town, *Moyle Rogers* s.n. (BM); Near the Touw River, 21st Aug. 1814, *Burchell* 5745 (K); Strangeways, George, Aug., *Egerton-Bird* s.n. sub. NBG 52718 (NBG); Kaymans Gat, 800 ft., 5/9/1831, *Drège* 187c (P).

KNYSNA: On the rocky edges of Plettenberg Bay glens, *Bowie* s.n. (BM); Springfield and edge of forest near the Poort, *Bowie* s.n. (BM); In fynbos on plateau above ridge at van der Watts Hoek, Knysna, Oct., *Keet* 1013 (PRE), sub. 13106 in STE; Between Knysna and Avontuur, Aug., *Salter* s.n. (BOL); Millwood, slopes south of Streepbosch creek, Sept., *Fourcade* 5294 (BOL); Petrus Brandt, Sept., *Phillips* 99 (BOL, GRA); Concordia, Knysna, July, *Kapp* 94 (PRE, K, Z); Plettenberg Bay, Sept., *Smart* s.n. sub. PRE 15524 (PRE, K); Plateau above van der Watts Bos, Oct., *Keet* 1073 (GRA); Plettenberg Bay, Oct., *Rogers* 27663 (K, G).

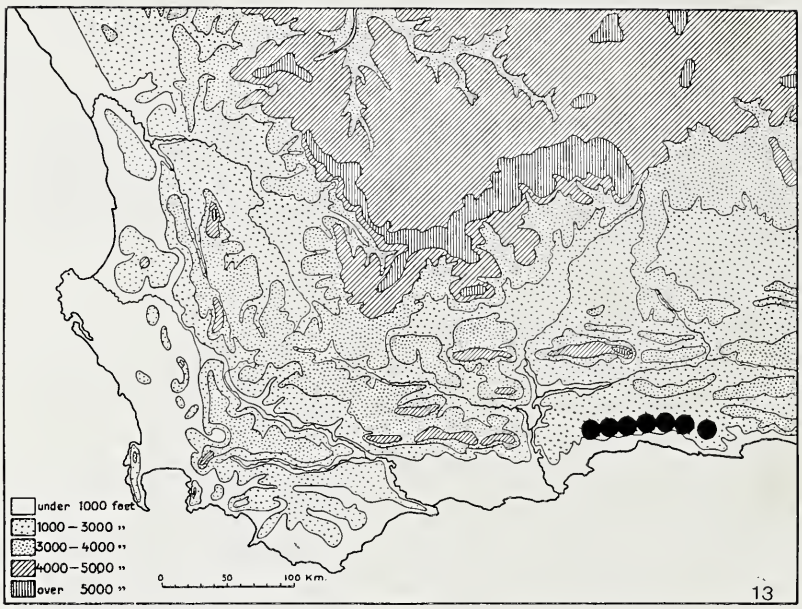
WITHOUT PRECISE LOCALITY: South Africa, *Mund* s.n. (K, PRE).

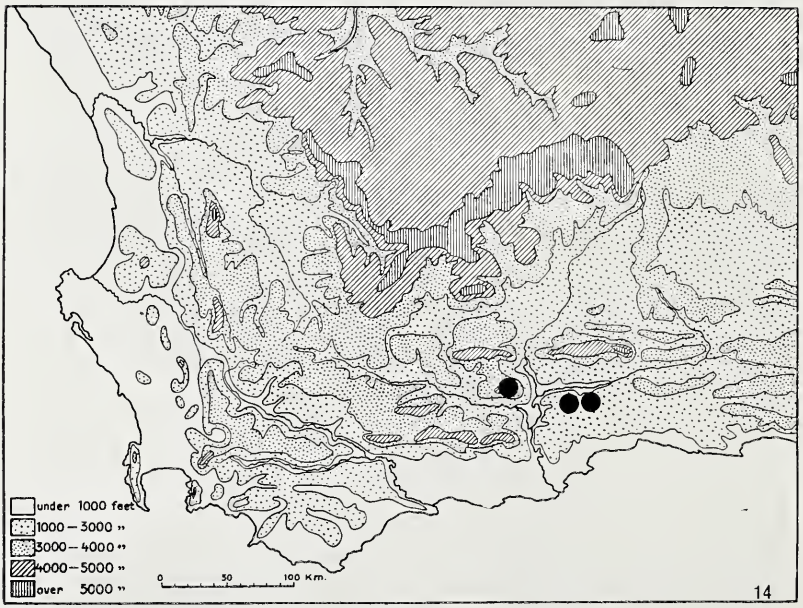
(7) **Leucospermum pluridens** Rourke, sp. nov.

L. pluridens a caulium indumentiis spisse arachnoidiis cinerascenti, bracteis longissima (2,0 cm) recurvatis marginibus ciliatis, et folio apice inciso 7–10 dente obtuso, distinguitur.

Frutex rigide erectus, 2,0—3,0 m altus, arborescens. *Caules* crassi 8,0—10,0 mm in diam. Indumentum spisse arachnoideum, cinereum. *Folia* oblonga-oblanceolata, 5,5—10,0 cm longa, 2,0—3,5 cm lata, glabri, coriacea; apices 7–10 dentes rotundatos incisos, gerentes. *Inflorescentiae* ovoideae, 8,0 cm longae, 6,0 cm latae, solitariae vel usque ad quartae fasiculatae. *Receptaculum involucrali* anguste conicum, acutum, 3,5—4,0 cm longum, 1,0 cm latum. *Bracteae* ovatae, cartilagineae, 2,0 cm longae, ad apicem versus acuminatae et recurvatae. Margines ciliati, paginam adaxialem nitentem carmineum. *Perianthium* rectum ad leviter arcuatum, anthesis initio 3,5—4,0 cm longum, flavidum, rubescens, sparsum hirsutum. *Stylus* rectus ad leviter arcuatus, crassus, 5,0—6,0 cm longus, 1,5 mm in diam. *Stigma* conicum acutum.

An erect, rigid, tree-like shrub to 3,0 m in diam., with a stout woody trunk to 20,0 cm in diam. Bark on basal branches and trunk smooth, grey. Young plants rather sparsely branched with stiffly erect stem, older plants becoming more divaricate. *Flowering stems* stout, woody, 8,0—10,0 mm in diam., with a thick villous to arachnoid cinereous indumentum of short crisped hairs. *Leaves* glabrous and coriaceous, subimbricate, oblong to broadly oblanceolate-cuneate, 5,5—10,0 cm long, 2,0—3,5 cm wide. Leaf apex rounded, bearing 7 to 10 very prominent, rounded teeth, frequently deeply incised. *Inflorescences* sessile to subsessile, ovoid, 8,0 cm long, 6,0 cm wide, usually borne singly but occasionally with up to 4 inflorescences per flowering shoot. *Involucral receptacle* narrowly conical, acute, 3,5—4,0 cm long, 1,0 cm broad. *Involucral bracts* ovate, carinate on adaxial surface; the apex caudate, very long acuminate, recurved, up to 2,0 cm long, margins fringed with long cilia, the adaxial surface shiny and carmine in live state. *Bracteoles* cartilaginous, obtrullate, carinate on adaxial surface, 1,0 cm long, 0,6 cm broad, apex long acuminate, somewhat incurved, margins ciliate. *Perianth tube* 10,0 mm long, cylindric, somewhat laterally compressed, glabrous but slightly puberulous distally on the abaxial surface.





FIGS. 13 AND 14.
(13) Distribution of *Leucospermum glabrum* Phillips.—(14) Distribution of *Leucospermum pluridens* Rourke.

Perianth claws yellow when fresh, becoming bright carmine with age, particularly on the inner surface; hirsute, with long straight trichomes interspersed between a dense, shortly villous indumentum. Median adaxial claw glabrous proximally. *Perianth limbs* broadly lanceolate, acute, 5,0 mm long, 2,0 mm wide, covered with a dense indumentum of short crisped hairs, the three abaxial limbs beset with long silky trichomes. *Style* 5,5—6,0 cm long, 1,5 mm in diam., straight to slightly arcuate, tapering in the subterminal region. *Pollen presenter* conic acute, orange, upper half yellow; stigmatic groove terminal, green when fresh. *Hypogynous scales* subulate, 2,0 mm long, white.

Diagnostic Characters: L. pluridens is distinguished from the related *L. glabrum* by the villous to arachnoid, cinereous indumentum on the flowering stems, the narrowly conic acute involucral receptacle, the exceptionally long (up to 2,0 cm) recurved, acuminate bracteoles with ciliate margins and the deeply incised leaf apices bearing 7 to 10 blunt teeth.

Type Material: Oudtshoorn district, between Saffraan Rivier and Kruis Pad, north side of the Robinson Pass, 17th Oct. 1966, *Rourke* 621, holotype in Compton Herbarium, Kirstenbosch, (NBG).

Dr. M. R. Levyns made the first recorded collection of this species on the Rooiberg Pass, near Calitzdorp in 1938. It is quite astonishing that such a prominent shrub should have been overlooked for so long, especially since *L. pluridens* also grows on the north slopes of the Outeniqua Range near the old Attaquas Kloof pass, which was crossed by Thunberg, Masson and many other early collectors.

Distribution and Ecology: To date, *L. pluridens* has been recorded from the northern foothills of the Outeniqua mountains in the vicinity of Kruis Pad, Saffraan Rivier and "Klein Moeras Rivier Spruiten", between 1 600 ft. and 2 000 ft. and also along the south eastern ridges of the Rooiberg between 2 500 ft. and 3 500 ft.

At both these localities the populations occur in Arid Fynbos transitional between Fynbos, and Karroid vegetation. This is particularly evident at Kruis Pad where the plants are scattered on hot, dry, north facing hills, growing in association with various *Restionaceae*, *Elytropappus sp.*, *Aloe ferox* and *Cotyledon sp.* Throughout its known distribution range, *L. pluridens* is confined to a zone receiving 10–15″ of rainfall p.a. The ecological requirements of *L. pluridens* are thus very different from the related species, *L. glabrum*. Flowering takes place from September to December.

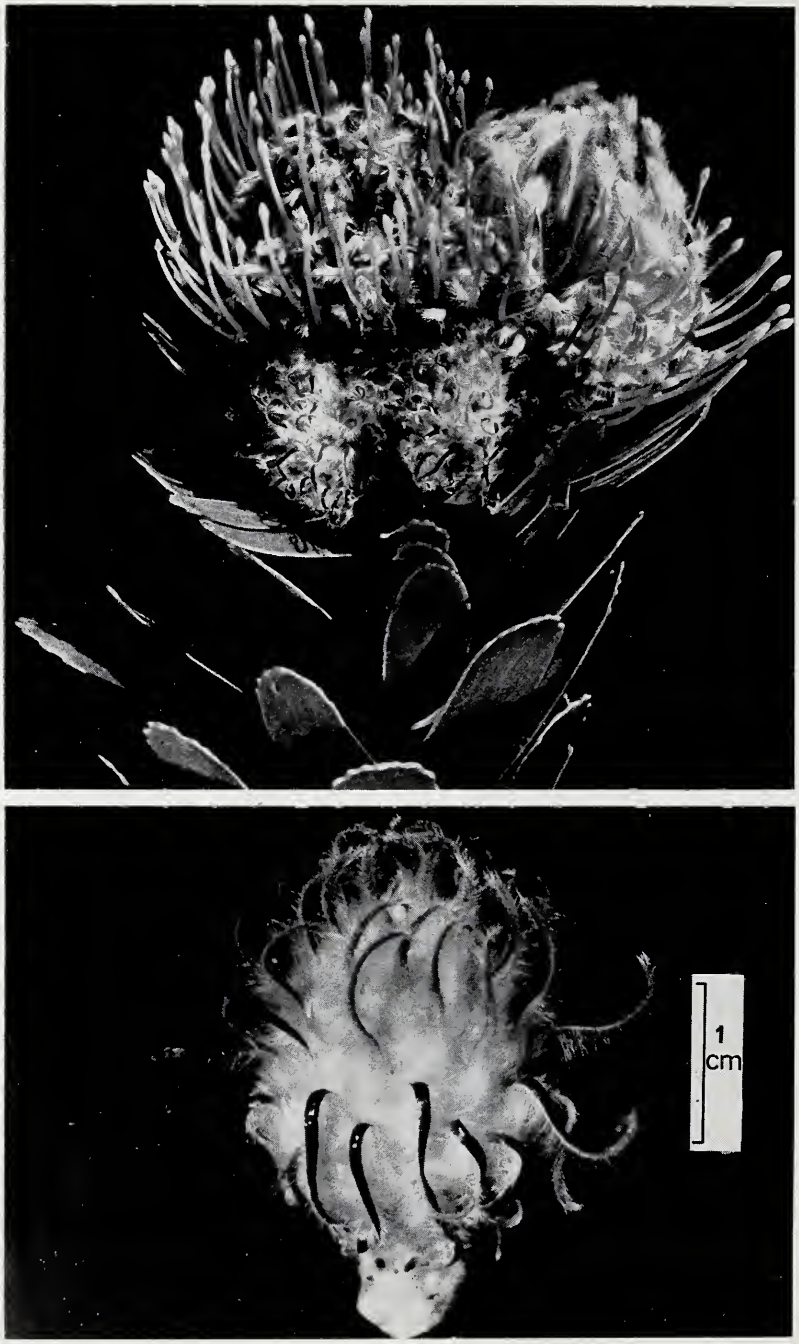


FIG. 15.

Leucospermum pluridens Rourke. A flowering shoot ($\frac{3}{4}$ natural size) and an immature inflorescence bud (below) showing the characteristic acuminate and recurved involucral bracts; from the type collection, *Rourke* 621.

Specimens Examined:

CAPE

LADISMITH/CALITZDORP: Rooiberg, at the top of the pass, Sept., *Levyns* 6629 (CT); Along the crest of the Rooiberg, west of the Rooiberg Pass, Nov., *Wurts* 1628 (NBG); Rooiberg Pass, south east side, Sept., *Rourke* 855 (NBG).

OUDTSHOORN: Klein Moeras Rivier Spruiten, Dec., *Compton* 23149 (NBG, BOL); North side of Outeniqua mountains, near Moeras Rivier, Dec., *Esterhuysen* 19485 (BOL); Kruis Pad, Nov., *Compton* 21746 (NBG); Between Saffraan Rivier and Kruis Pad, north side of Robinson Pass, Oct., *Rourke* 621 (NBG); Kruis Pad, north slopes of the Outeniqua's, Sept., *Rourke* 851 (NBG).

Sect. 3. TUMIDITUBUS Rourke, sect. nov.

Frutices erecti vel decumbentes, caule singularis principalis. Receptaculum involucrale conicum vel conicum depressum. Tubus perianthii contractus proximalis, inflatus distalis.
Erect or sprawling shrubs with a single main stem. Involucral receptacle conic or conic depressed. Perianth tube narrowed proximally, inflated distally.

Type: *L. praecox* Rourke.

Two rather complex pairs of vicarious taxa are discussed in this section.

(A) The *L. praecox*/*L. fulgens* group.

Some of the principal differences between two vicarious populations of *Leucospermum* in this section occurring on the southern Cape coastal flats are illustrated in fig. 16. The larger of the two populations extends from Albertinia to Mossel Bay while the smaller is confined to the farm Cupido's Kraal, south of the Potteberg. An obvious difference between them is the colour of the perianth and style which is yellow becoming orange in the Albertinia—Mossel Bay population and deep pink or orange becoming brilliant crimson in the Cupido's Kraal population. The Albertinia—Mossel Bay population commences flowering in April and reaches a peak in May and June after which the inflorescences persist until September. At Cupido's Kraal, flowering commences in August and reaches a peak during September and October with the inflorescences persisting until December and January. Even if these two populations were sympatric, interbreeding would therefore be unlikely.

Morphological differences are less obvious. Style length fails to provide an absolute distinction between the two populations although it is perfectly clear that the Cupido's Kraal population has longer styles (fig. 16). The form of the leaves and the toothing of the leaf apex provide the most reliable characters for separating the populations. At Cupido's Kraal the leaves are oblanceolate to oblong with 2–4 (usually 3) blunt, rounded teeth. Specimens from the Albertinia—Mossel Bay area have obovate leaves with 5–11 (usually 6 or 7) rather acute teeth at the apex. A further character to be considered is the pube-

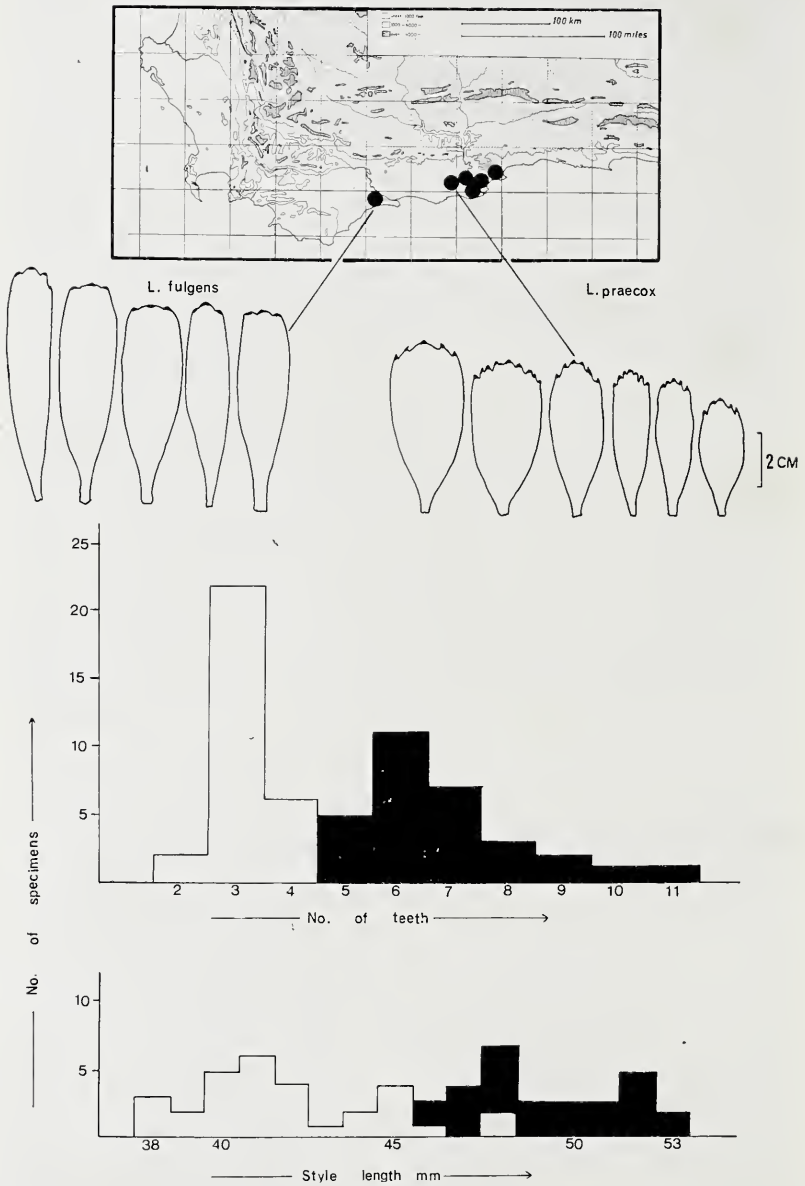


FIG. 16.

Distribution of *Leucospermum praecox* Rourke and *L. fulgens* Rourke, showing the range of variation in the leaves, the number of apical teeth on the leaves and variation in the style length. In the histograms showing variation in the number of teeth on the leaf apex, the blackened histogram represents *L. praecox*. In the histograms showing variation in style length the blackened histogram represents *L. fulgens*.

scence of the perianth, which is puberulous in the Albertinia—Mossel Bay material and villous in the Cupido's Kraal material.

Taking into account the biological and morphological differences between these two populations, it is considered that they should be treated as closely related species. The Albertinia—Mossel Bay population is described as *L. praecox* and the material from Cupido's Kraal as *L. fulgens*.

(B) The *L. spathulatum*/*L. profugum* group.

Along the main chain of mountains running in a north-south direction from the Cedarberg through the Cold Bokkeveld to Worcester, there is a series of variable populations of a prostrate species of *Leucospermum*, isolated on the higher peaks, to which the name *L. spathulatum* R. Br. (= *L. cereris*) Compton has been applied. Material collected on the Piketberg has been included in

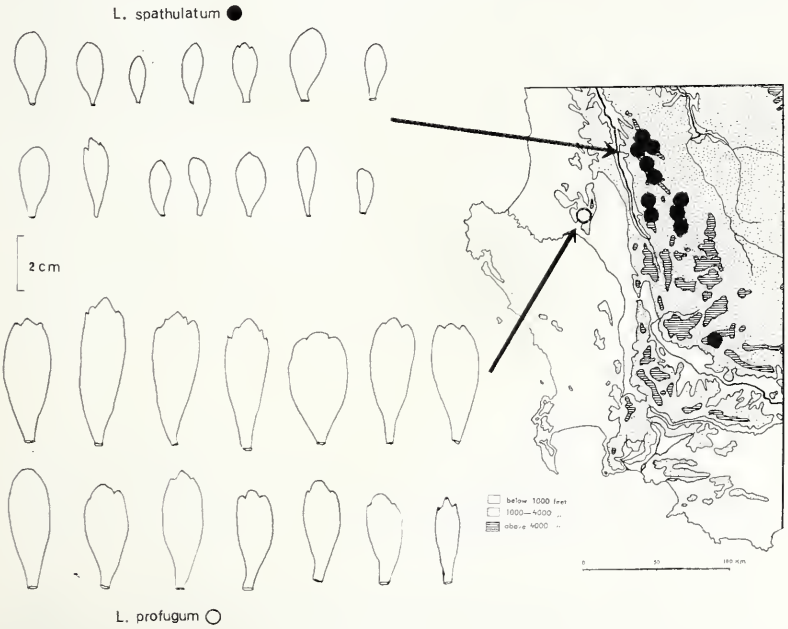


FIG. 17.
Distribution of *Leucospermum spathulatum* R. Br. and *Leucospermum profugum* Rourke showing differences in the leaf dimensions and the number of teeth at the leaf apex.

L. spathulatum. A decumbent growth habit, conic involucral receptacle, incurved, arcuate style and an infundibuliform perianth tube characterises these populations.

Mature plants of the Piketberg population produce a few long, trailing or looping, main stems which are almost entirely unbranched and are devoid of leaves for the greater part of their length except on the terminal growths. Moreover, the populations on the Piketberg appeared larger than the Cedarberg —Cold Bokkeveld forms, in several morphological characters, notably flower and leaf size. In addition, the leaves are consistently glabrous with 3 or 4 teeth at the apex (fig. 17).

A dense matted growth habit is typical of material from the Cedarberg and Cold Bokkeveld. This is due to development of short lateral branchlets on the flowering stems. This material is further characterised by the grey, crisped pubescence on the leaves, although nearly glabrous forms do arise at random within this geographical range. The leaves are nearly always entire (rarely with teeth at apex) and are perceptibly smaller than those of the Piketberg population.

Style length was taken as an easily and accurately measurable parameter of flower size. A sharp distinction may be drawn between the two populations with regard to style length (fig. 18). Variation in the leaf dimensions is almost continuous but although no clear cut distinction can be drawn it is evident that the leaves of the Piketberg population are significantly larger than those of the Cedarberg—Cold Bokkeveld material (fig. 18). Material from an outlying population on Sawedge Peak, Worcester, falls into this latter group, for, while the leaves from this population are rather larger than normal, the style length is well within the range of the Cedarberg—Cold Bokkeveld material.

Taking into account also the fairly consistent differences in leaf pubescence and the number of teeth on the leaf apex, already mentioned, it is considered advisable to recognize the isolated population on the Piketberg as a distinct species, *L. profugum*.

(8) **Leucospermum praecox** Rourke, sp. nov.

L. praecox speciebus aliis caule principali singulo distinguitur, a foliis obovatis vel late cuneatis, apicibus 6–10 dentatis, receptaculo involucrali late conico, perianthio puberulo, tubo distali inflato, stylo 3,8—4,8 cm longo, stigmate angusto conico acuto.

Frutex erectus, 2,0—3,0 m altus, 4,0 m in diam., caule principali singulo. *Caules* 0,5—1,0 cm in diam. Indumentum dense, laxe, crispum, cinerascens. *Folia* laxe imbricata, ascendentia; glabra, obovata vel late cuneata, 3,5—7,0 cm longa, 1,5—3,0 cm lata, 6–11 dentata. *Inflorescentiae* sessiles, globosae, 6,0 cm in diam. *Receptacalum involucrale* late conicum, acutum, 2,0 cm longum, 1,5 cm

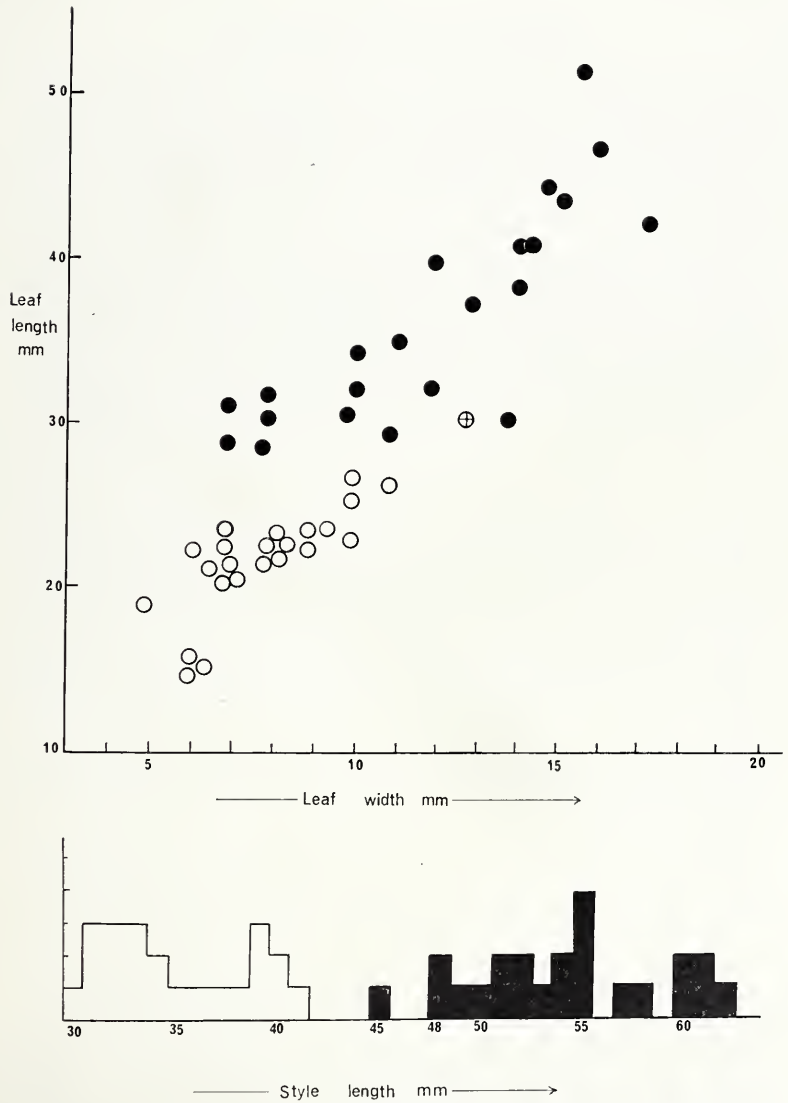


FIG. 18.

Variation in the leaf dimensions and style length in *Leucospermum spathulatum* R. Br. and *L. profugum* Rourke. In the scatter diagram the open circles represent the Cedarberg–Cold Bokkeveld population (*L. spathulatum*) with the outlying population on Sawedge Peak marked with a cross. The solid circles represent the Piketberg population (*L. profugum*). In the histogram showing variation in style length, the solid graph represents the Piketberg population and the open graph the Cedarberg–Cold Bokkeveld population.

latum. *Bracteae involucrales* arcte adpressae imbricatae, ovatae acute, 8,0 mm longae, 5,0 mm latae, cartilagineae, dense tomentosae, cinerascentes. *Perianthium* 3,0 cm longum, puberulum, luteum per anthesin. *Tubus perianthii* 6,0—8,0 mm longus, glaber et angustus proximalis, inflatus et puberulus distalis. *Stylus* 3,8—4,8 cm longus, arcuatus adaxilis. *Stigma* anguste conicum, acutum, 3,0 mm longum.

An erect, rounded shrub, 2,0—3,0 m in height, up to 4,0 m in diam., with a single, stout main stem to 8,0 cm in diam. Basal branches smooth, bark grey. *Flowering stems* terete, 0,5—1,0 cm in diam., covered with a dense, cinereous indentum of short crisped hairs interspersed with long, patent, silky trichomes. *Leaves* glabrous, obovate to broadly cuneate, 3,5—7,0 cm long, 1,5—3,0 cm broad, 6–11 toothed at the apex; loosely ascending imbricate. *Inflorescences* sessile, axillary, globose, 6,0 cm in diam.; up to 4 inflorescences produced on each branch. *Involucral receptacle* broadly conic, acute, 2,0 cm long, 1,5 cm wide. *Involucral bracts* tightly adpressed imbricate, ovate acute, 8,0 mm long, 5,0 mm wide, cartilaginous, densely tomentose, cinereous. *Bracteoles* obovate, abruptly acuminate, 10,0 mm long, 5,0 mm wide, very thickly lanate proximally, cartilaginous. *Perianth* 3,0 cm long, yellow on opening, becoming orange with age. *Perianth tube* 6,0—8,0 mm long, glabrous and narrow proximally, becoming minutely puberulous and inflated distally, constricted at junction with perianth claws. *Perianth claws* pale yellow; becoming recurved subterminally, puberulous. *Perianth limbs* narrowly lanceolate, 5,0 mm long, beset with long, straight, sericeous trichomes. *Anthers* subsessile, lanceolate. *Style* 3,8—4,8 cm long, adaxially arcuate, tapering subterminally, pale yellow becoming orange with age. *Pollen presenter* narrowly conical, acute, 3,0 mm long. *Hypogynous scales* 3,0 mm long subulate, hyaline.

Diagnostic Characters: L. praecox is distinguished by the broadly conic involucral receptacle, the obovate to broadly cuneate leaves, 6–11 toothed at the apex, the puberulous perianth, the inflated perianth tube, the style, 3,8—4,8 cm long and the narrowly conic acute pollen presenter.

Type Material: Riversdale district, on the sandy flats south of Aasvogelberg, a few miles east of Albertinia, 29th May 1967, *Rourke* 771 (holotype, NBG).

Mr. R. C. Alexander Prior made the first recorded collection of this species on the 2nd of August 1847, at Mossel Bay. It is a curious fact that this large and conspicuous shrub was bypassed, apparently unobserved by 18th and early 19th century collectors. This anomaly can only be explained by assuming that they closely followed the main waggon track to the east which skirted the southern foothills of the Langeberg and did not cross the Albertinia plateau.

Distribution, Ecology and Biology: L. praecox has a comparatively small area of distribution extending from Mossel Bay westwards, to a few miles west of Albertinia and thence southwards to coast between these two points.

Throughout this region *L. praecox* is locally common and several very dense communities can still be seen despite the aggressive advance of Australian wattles. Agricultural encroachment has also destroyed large tracts of this species near Albertinia. Except at Mossel Bay where *L. praecox* grows on soils derived from Table Mountain Sandstone, all other populations occur on deep white stabilized sand which is late Tertiary to recent in origin. It is a fairly large species eventually attaining a height of 3 metres and a diameter of up to 4 metres. *L. praecox* is remarkable in that it commences flowering in April and May. By September, the yellow perianths have faded but the styles persist, becoming bright orange in colour.

Specimens Examined:

CAPE

RIVERSDALE: Between Albertinia and the Gouritz River mouth, April, *Rycroft* 1888 (BOL, NBG); Half a mile east of Albertinia, July, *Rourke* 11 (BOL, NBG); Albertinia commonage, Aug., *Muir* 639 (PRE); One mile along the Albertinia—Mossel Bay road, Oct., *van Breda* 736 (PRE); Riversdale flats, Feb., *Marloth* 3611 (PRE); Gouritz River mouth, Nov., *Levyns* 9526 (CT); Albertinia, Sept., *Levyns* 9161 (CT); One mile east of Albertinia, Sept., *Salter* 6361 (BOL, BM, K); Sandy flats south of Aasvogelberg, Albertinia, May, *Rourke* 771 (NBG); Albertinia, Aug., *Compton* 15752 (NBG), *Parker* 4431 (NBG, K); Albertinia commonage, 1 mile east of Albertinia, Sept., *Garside* 4808 (SAM, K); Riversdale, *Muir* s.n. no. 5641 in herb. Marloth (PRE); Between Albertinia and Mossel Bay, Dec., *Noel* 1345 (GRA); Four miles from Gouritz River mouth, Sept., *Middlemost* 2115 (NBG); On the road to the Fisheries, near Albertinia, Aug., *Hall* 539 (NBG).

MOSSEL BAY: 5 miles from Mossel Bay on the Albertinia road, Dec., *Marais* 583 (PRE, GRA, K); 0,4 miles w. of Mossel Bay, Oct., *Lewis* 3677 (SAM); In Collibus pone Mossel Bay, Jan., *Bolus* s.n. (BOL); Mossel Bay, Feb., *Walgate* 209 (NBG); Sept., *Walters* 104 (NBG); Oct., *Martin* 253 (NBG); Jan., *Guthrie* 4377 (NBG); Vicinity of Mossel Bay, Sept., *Rodin* 1347 (PRE, K); 6 to 8 miles w. of Mossel Bay, Jan., *Gentry and Barclay* 19123 (PRE); Mossel Bay, Aug., *Alexander Prior* s.n. (K).

(9) **Leucospermum fulgens** Rourke, sp. nov.

L. fulgens ab speciebus cognatis distat, foliis oblanceolatis vel oblongis, 1–3 dentati, stylo 4,6—5,3 cm longo, leviter arcuato, perianthio villoso.

Frutex procerus, erectus, rotundatus, ad 3,0 m altus 4,0 m in diam.; caule principali singulare. *Caules* erecti, rigidi, 5,0—7,0 mm in diam. *Folia* oblanceolata vel oblonga, 6,0—9,0 cm longa, 1,5—2,0 cm lata, plerumque 3 dentata, glabra, coriacea, laxe assurgentia. *Inflorescentiae* globosae vel ovoideae, 6,0—8,0 cm in diam., plerumque singulares. *Receptaculum involucrale* conicum acutum, 2,0—4,0 cm longum, 1,5 cm latum. *Bracteae involucrales* ovatae acute, 10,0 mm longae, 7,0—8,0 mm latae, arcte adpressae imbricatae, cartilagineae, cinerascentes. *Perianthium* 3,5—4,0 cm longum, carneum vel aurantiacum,

rubescens. *Tubus perianthii* 8,0—10,0 mm longus, angustus et glaber proximalis, tumidus et puberulus distalis. *Segmentum perianthii* circinatum subterminale, villosum. *Stylus* 4,6—5,3 cm longus, leviter arcuatus. *Stigma* conicum anguste acutum, 4,0 mm longum.

An erect, rounded shrub to 3,0 m in height, up to 4,0 m in diam.; with a single stout main stem up to 10,0 cm in diam.; bark smooth, grey. *Flowering* stems fairly stout, rigid, 5,0—7,0 mm in diam., covered with a sparse indumentum of fine crisped hairs; soon becoming glabrous. *Leaves* oblanceolate to oblong, 6,0—9,0 cm long, 1,5—2,0 cm broad with 2—4 teeth, usually 3, at the apex; glabrous, coriaceous. *Inflorescenses* sessile to subsessile, peduncle up to 10 cm long; globose to ovoid, 6,0—8,0 cm in diam., usually single but occasionally in groups of 2. *Involucral receptacle* conic acute, 2,0—4,0 cm long, 1,5 cm broad. *Involucral bracts* tightly adpressed imbricate, ovate, acute, 10,0 mm long, 7,0—8,0 mm wide, densely tomentose, cartilaginous, cinereous. *Bracteoles* ovate cuspidate, 6,0 mm long, 4,0 mm broad, very densely lanate. *Perianth* 3,5—4,0 cm long, pink to orange becoming brilliant crimson with age. *Perianth tube* 8,0—10,0 mm long, narrow and glabrous proximally, inflated and puberulous distally, becoming constricted at the junction with the perianth claws. *Perianth claws* villous, the margins beset with long, straight, spreading trichomes; becoming strongly coiled subterminally at anthesis. *Perianth limbs* lanceolate acute, 5,0 mm long, villous. *Anthers* sessile, elliptic, 4,5—5,0 mm long, apical boss rounded, yellow. *Style* 4,6—5,3 cm long, almost straight to slightly adaxially arcuate. *Pollen presenter* narrowly conic acute, 4,0 mm long, stigmatic groove terminal. *Hypogynous scales* 2,0 mm long, subulate.

Diagnostic Characters: L. fulgens is distinguished by the oblanceolate to oblong glabrous leaves usually with 3 teeth at the apex, the villous perianth, the style, 4,6—5,3 cm long, the conic involucral receptacle and the inflated perianth tube.

Type Material: Bredasdorp district, between Hamerkop Hill and Elands Pad, Potteberg, 15th Oct., 1967, *Rourke* 948 (holotype, NBG).

Distribution, Ecology and Biology: A single population of *L. fulgens* is known. This is situated in the Bredasdorp district, on the south side of the Potteberg on the farm Cupido's Kraal, more or less midway between Potteberg farm and Eland's Pad farm.

Ecologically, *L. fulgens* is a very specialised species. The only population known occurs exclusively on partially stabilized sandy hillocks which have accumulated in the trough formed between the Potteberg range (Table Mountain Sandstone) and the ridge of limestone hills (Alexandria beds), which run

parallel to the coast. These hillocks, at an elevation of 500 ft., form a narrow zone and are composed of deep white sand, Tertiary to recent in origin. Despite the fact that this belt is only a few hundred yards wide, no colonization of the adjacent limestone or rocky Table Mountain Sandstone slopes by *L. fulgens*, has been observed. This leads one to conclude that the ecological amplitude of this species is restricted. Apart from tall, tufted *Restionaceae* and species of *Passerina* and *Metalasia*, *L. fulgens* constitutes the major component of the vegetation cover. The very dense but local stands cover several acres. A winter rainfall of 15–20″ p.a. is experienced. The bright pink to deep orange inflorescences are produced from August to November, becoming brilliant crimson with age and persisting until January.

Specimens Examined:

CAPE

BREDASDORP: Cupido's Kraal, south slopes of Potteberg, Dec., *Rourke* 276 (NBG); Two miles south of Potteberg farm, Sept., *Rourke* 603 (NBG); Between Potteberg and Cape Infanta, Nov., *Rycroft* 1748 (NBG); Between Hamerkop Hill and Eland's Pad, Oct., *Rourke* 948 (NBG).

(10) **Leucospermum truncatum** (Buek ex Meisn.) Rourke in Jl S. Afr. Bot. **33:** 266 (1967).
Leucospermum truncatum Buek in Drège, Zwei Pfl. Geog. Docum.: 123, 199 (1843)—nom. nud.
Leucospermum zeyheri Meisn. var. *truncatum* Buek ex Meisn. in DC., Prodr. **14:** 256 (1856). Syntypes: Cape of Good Hope, *Ludwig* 21 in herb. Meisn. (NY); Between Potberg and Cape Agulhas, 3/8/1831, *Drège* 8057, (P, K, G; fragment in herb. Meisner, NY, lectotype).
Leucadendron truncatum (Buek ex Meisn.) O. Kuntze, Rev. Gen. Pl. **2:** 578 (1891).

Erect, rounded, well branched shrubs to 2,0 m in height, with a single main stem. *Flowering stems* stiffly erect, 5,0 mm in diam., covered with a dense indumentum of fine crisped hairs. *Leaves* oblanceolate to narrowly cuneate, glabrous, 4,5—9,0 cm long, 0,8—1,5 cm wide, apex truncate, usually tridentate. *Inflorescences* globose, 3,0—4,0 cm in diam., 2 or 3 nate, rarely solitary; pedunculate, peduncle to 2,0 cm long. *Involucral receptacle* conic acute, 0,8—1,5 cm long, 0,8—1,0 cm wide. *Involucral bracts* broadly ovate acuminate, 0,8—1,0 cm long, 0,6 cm wide, cartilaginous, imbricate, densely tomentose to lanate. *Bracteoles* broadly obovate, cuspidate 7,0 mm long, 5,0 mm wide, densely lanate. *Perianth* 1,2—1,8 cm long, golden-yellow. *Perianth tube* 5.0 mm long puberulous distally becoming glabrous proximally and narrowing to half the distal diameter. *Perianth claws* thickly villous to densely lanate. *Perianth limbs*

elliptic 2,5 mm long, villous. *Style* 1,8—3,5 mm long, straight or somewhat adaxially incurved. *Pollen presenter* 1,0—2,0 mm long, cylindric obtuse to clavate; stigmatic groove terminal. *Hypogynous scales* linear, 1,0 mm long.

Diagnostic Characters: L. truncatum may be distinguished by its oblanceolate cuneate leaves, 0,8—1,5 cm wide, the style, 1,8—3,8 cm long, the cylindric obtuse to clavate pollen presenter, the villous to lanate perianth claws and the perianth tube which is sharply narrowed proximally. It is confied to limestone formations.

The name *Leucospermum truncatum* was first proposed by Buek who applied it to a collection made by Drège in August 1831 on the limestone hills between Cape Agulhas and the Potteberg but as no description was published *L. truncatum* Buek is a nomen nudum. Several years later Meisner adopted the epithet "truncatum" for a variety of *Leucospermum zeyheri* Meisn., citing Bueks nomen nudum and giving a complete latin description. Two collections were cited by Meisner, namely, *Drège* 8057 (quoted incorrectly as 8957) and *Ludwig* 21. Both are represented by small fragments in Meisner's personal herbarium. Meisner's description appears to have been based on both elements but as the Drege collection is more widely distributed it has been chosen as the lectotype.

Distribution, Ecology and Biology: The range of *L. truncatum* extends from the Soetanysberg in the west, eastwards, through the Bredasdorp district along the ridge of limestone hills adjacent to the coast, to Vermaaklikheid, near the mouth of the Duivenhoks River.

L. truncatum occurs exclusively on deposits of the Alexandria formation. This association with limestone or limestone derived soils is very intimate as in most cases the roots penetrate the crevices in outcrops of pure limestone. Dense stands are formed generally in association with *Leucadendron muirii*, *L. meridianum* and *Protea obtusifolia*. All populations are found in close proximity to the coast at elevations varying from sea level to 800 ft. A mean annual rainfall of 15–20″ p.a. is experienced, mainly falling in winter. Flowering takes place from August to December. On opening, the perianths and styles are bright yellow but become orange with age.

Variation: Several local variants occur within the species here delimited as *L. truncatum* particularly at the western and eastern extremities of its range. The most westerly populations at the western end of the Soetanysberg (on the farms Hangnes and Rietfontein) are characterised by exceptionally long leaves (to 9,0 cm), large inflorescences and large, very densely lanate involucral bracts. The most easterly populations occurring between the Breede River mouth and Vermaaklikheid have leaves which are more obovate than oblanceolate, suggesting an affinity with *L. praecox*.

Specimens Examined:

CAPE

BREDASDORP: Rietfontein Poort, Dec., *Schlechter* 9696 (PRE, S, G, BM, K, Z, PH); The Poort, Bredasdorp, Sept., *Compton* 4381 (BOL); Flats between Elandspad and Noetze, Oct., *Pillans* 9425 (BOL); Limestone hills near the Potteberg, Sept., *Esterhuysen* 23350 (BOL); De Hoop, April, *Barker* 8678 (NBG); Near Potteberg, Nov., *Rycroft* 1744 (NBG); St. Mungo Bay near Cape Agulhas, Sept., *Garside* 4680 (K); 7 miles west of Bredasdorp, Nov., *Salter* 4083 (BM, K); Kliprug, along limestone hills, Nov., *van Breda* 1048 (PRE); De Hoop, Sept., *van Breda* 1721 (PRE); Bredasdorp Poortjie, Oct., *van Breda* 714 (PRE, NBG, K); Sand Hoogte, Nov., *C. A. Smith* 4926 (PRE, K); Northumberland Point, Aug., *Acocks* 22627 (PRE); 6 miles west of Bredasdorp, Nov., *Gentry and Barclay* 18845 (PRE); The Poort, Bredasdorp, Sept., *Acocks* 1530 (S); Between Potteberg and Cape Agulhas, 3/8/1831, *Drège* 8057 (P, G, K, NY); Summit of Soetanysberg, Oct., *Rourke* 1126 (NBG); Springfield, Soetanysberg, Nov., *Williams* 49 (NBG); Springfield, Jun., *Rycroft* 1827 (NBG, BOL); The Poort, Sept., *Compton* 4381 (NBG); De Hoop, Sept., *Middlemost* 2206 (NBG); Limestone hills between De Hoop and Bredasdorp, Sept., *Rourke* 599 (NEG); Arniston, Nov., *Topper* 505 (NBG); The Poort, Aug., Dec., *Compton* 9077, 23197 (NBG); 10 miles east of Gansbaai, Nov., *L. E. Taylor* 4889A (NBG); Struisbaai, Sept., *Williams* 884 (NBG); Springfontein, Dec., *Rourke* 1178 (NBG); Hill ¼ mile west of Cape Agulhas, Dec., *Pillans* 8149 (BOL, K); Zoetwater valley, Dec., *Krauss* s.n. (FI); Nachtwacht—Marthas Gat borderline, Nov., *C. A. Smith* 4911 (BM, PRE); Plain south of mountain range on Elim rd., Dec., *Galpin* 11203 (PRE); Limestone hills at Cape Agulhas, Dec., *Acocks & Hafstrom* 2107 (PRE, S); The Poort, Bredasdorp, Nov., *H. C. Taylor* 4318 (STE, PRE).

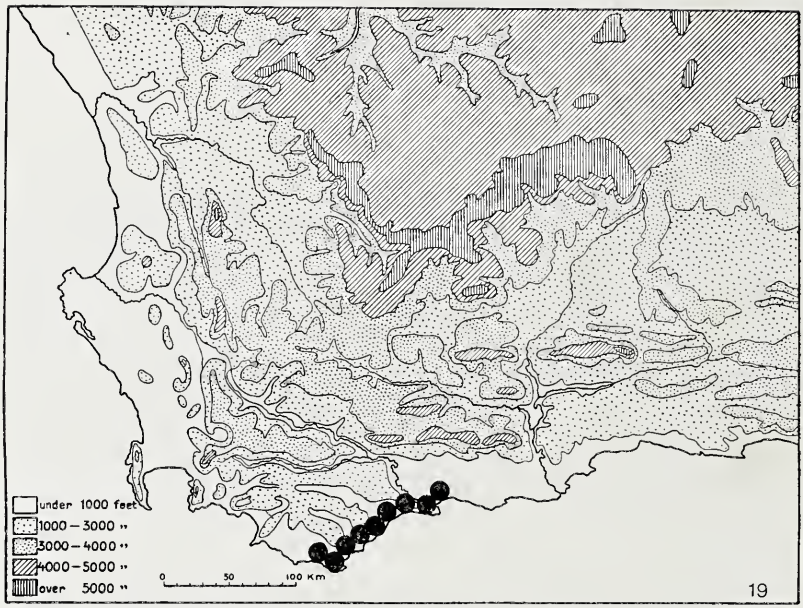
SWELLENDAM: San Sebastian, near Cape Infante, Nov., *Esterhuysen* 29360 (BOL); 2 miles south east of Potteberg farm, Sept., *Rourke* 597 (NBG); Between Hamerkop Hill and Eland's Pad, Oct., *Rourke* 949 (NBG); Grasrug, Cape Infante, *Rourke* 278 (NBG); 2 miles south east of Potteberg farm, Sept., *Rourke* 605 (NBG); San Sebastian estate, Breede River mouth, Oct., *Rourke* 19 (BOL).

HEIDELBERG: Vermaaklikheid, Oct., *Williams* 548 (BOL, NBG); 11 miles south of Riversdale, Sept., *Richmond* 9 (NBG); Vermaaklikheid hills, near village, Oct., *Rourke* 626 (NBG); Puntjie hills, at mouth of Duivenhoks River, Oct., *Rourke* 625 (NBG).

WITHOUT PRECISE LOCALITY: Cape of Good Hope, *Ludwig* 21 in herb. Meisner (NY); Cape of Good Hope anno 1831, *Jules Verreaux* s.n. (G).

(11) **Leucospermum muirii** Phillips in Kew Bull. **1910:** 332 (1910); Phillips & Stapf in Fl. Cap. **5:** 627 (1912). Syntypes: Milkwoodfontein, *Galpin* 4457 (GRA, PRE, K); Zandhoogte, *Muir* s.n. no. 5309 in herb. Galpin (Lectotype, PRE).

An erect, rounded, much branched shrub to 1,5 m in height, with a single main stem. *Flowering stems* slender, 2,0—3,0 mm in diam., covered with a short, crisped, cinereous indumentum at first, soon glabrous. *Leaves* very narrowly cuneate to cuneate-linear, 4,0—6,0 cm long, 4,0—10,0 mm wide, with 3–7 teeth at apex; pubescent at first, with a short, crisped indumentum, soon glabrous. *Inflorescences* solitary, 2, 3, or 4 nate; globose, 2,0—3,0 cm in diam.; pedunculate, peduncle 1,0—2,0 cm long. *Involucral receptacle* conic depressed, 1,0 cm long, 0,8 cm wide. *Involucral bracts* ovate acuminate, 7,0—8,0 mm long, 4,0 mm wide, tightly imbricate, cartilaginous, villous, apex acummiate, cinereous. *Bracteoles* broadly obtrullate—acuminate, 7,0 mm long,





FIGS. 19 AND 20.
(19) Distribution of *Leucospermum truncatum* (Buek ex Meisn.) Rourke.—(20) Distribution of *Leucospermum muirii* Phillips.

5,0 mm wide, densely lanate proximally, cartilaginous. *Perianth* 12,0—15,0 mm long, pale yellow to yellowish green. *Perianth tube* 5,0 mm long, cylindric to slightly compressed laterally; glabrous proximally, minutely puberulous distally. *Perianth claws* puberulous to sparsely villous. *Perianth limbs* narrowly lanceolate, 2,0 mm long; outer surface of the 3 adaxial limbs sericeous, abaxial limb sparsely sericeous. *Style* 1,3—2,2 cm long, straight. *Pollen presenter* clavate-cylindric, 1,0 mm long, indistinctly differentiated from the style. *Hypogynous scales* 1,0 mm long, subulate, pale yellow.

Diagnostic Characters: L. muirii is distinguished by its small globose inflorescences, 2,0—3,0 cm in diam., the narrowly cuneate leaves 4,0—10,0 mm wide, the short style 13,0—22,0 mm long and the puberulous to sparsely villous perianth claws.

Two syntypes were cited by Phillips in the original description of *L. muirii* and of these, the collection by Muir from Zandhoogte (*Muir* s.n. no. 5309 in herb. Galpin, PRE), has been chosen as the lectotype. The material bears a determinavit label signed by Phillips and also his drawing of the floral parts, which seems to indicate that this specimen was used for the original description. Specimens gathered by Dr. John Muir in 1909 appear to be the first recorded collection of *L. muirii.*

Distribution, Ecology and Biology: Rather restricted in its range, *L. muirii* is confined to the Albertinia plateau where it occurs a few miles west and east of the town and southwards towards the coast, chiefly in the vicinity of Melkhoutfontein and Still Bay.

In contrast to *L. truncatum* which grows on limestone formations in the same region, *L. muirii* is found only on deep, white sand of Late Tertiary or Recent origin. Small dense communities are frequent on sandy flats, growing in association with tall Restionaceae, *Leucadendron galpinii*, *Protea repens*, *Leucospermum praecox* and various Ericaceae. Flowering takes place between July and October.

Specimens Examined:

CAPE

RIVERSDALE: 7 miles from Albertinia on Riversdale Rd., Dec., *Marais* 587 (PRE, GRA, NBG); Melkhoutfontein, Oct., *Muir* 4769 (PRE, NH); Zandhoogte, Riversdale dist., June, *Muir* s.n. no. 5309 in herb. Galpin (PRE); Near Albertinia, June, *Muir* 612 (PRE); Riversdale, *Muir* 17 (GRA); Milkwoodfontein, Oct., *Galpin* 4457 (GRA, K); One mile west of Albertinia, Sept., *Salter* 6365 (BOL, K); Zandhoogte, *Muir* 737 (BOL, SAM, PRE); Still Bay hills, Aug., *Barker* 5544 (BOL, NBG); 1 mile from Albertinia, *Garside* 4810 (K); ½ mile east of Albertinia, July, *Rourke* 10 (BOL, NBG); Albertinia, Oct., *Esterhuysen* 25012 (BOL); Towards Albertinia, Sept., *Rodin* 1346 (BOL, PRE, K); On road to Still Bay, Nov., *Levyns* 9517 (CT); Soetbotters Vlakte north of Still Bay hills, Aug., *Johnson* 126 (NBG); De Kriet, 10 miles west of Albertinia, Oct., *Rourke* 612 (NBG); 15 miles from Riversdale to Still Bay, Jan., *Marsh* 1172 (STE).

(12) **Leucospermum erubescens** Rourke, sp. nov.

Inter species generis tubo perianthio tumido distali, *L. erubescens* inflorescentiae leviter asymmetricae manifeste et oblique pedunculatae, receptaculo involucrali oblique sphaerico vel conico depresso, perianthio uniformiter velutino, distinguitur.

Frutex erectus 2,0 m altus. *Caules* erecti, 0,5—1,0 cm in diam., trichomatibus densis crispis obsitis. *Folia* erecto-patentia, oblanceolata elliptica vel oblonga, 7,0—8,5 cm longa, 1,0—2,0 cm lata, glabra. Apex plerumque truncatus et tridentatus, aliquando rotundatus usque ad septem dentatum. *Inflorescentiae* singulare vel plurimae, plerumque 4–8 aggregatae, leviter asymmetricae, ovoideae, 5,0—6,5 cm in diam., manifeste et oblique pedunculatae. Pedunculus 2,0—3,0 cm longus. *Receptaculum involucrale* conicum depressum vel oblique sphaericum, 1,3 cm in diam. *Bracteae involucrales* late ovatae, 6,0—8,0 mm longae, 6,0 mm latae, arcte imbricatae, tomentosae, cartilagineae; apices abrupte acuminati. *Perianthum* rectum, 3,0—3,5 cm longum, uniformiter velutinum; luteum, erubescens post anthesin. *Tubus perianthii* 1,0—1,2 mm longus, angustatus et glaber proximalis, tumidus et puberulus distalis. *Stylus* 4,0—5,5 longus, leviter arcuatus adaxialis. *Stigma* clavatum vel cylindricum-obtusum, 3,0 mm longum.

An erect shrub to 2,0 m in height, with a single main stem; bark smooth, grey. *Flowering stems* erect, 0,5—1,0 cm in diam., covered with a dense indumentum of fine crisped hairs. *Leaves* oblanceolate-elliptic to oblong, 7 0—8,5 cm long, 1,0—2,0 cm wide, usually truncate and with 3 teeth, occasionally rounded and with up to 7 teeth at apex; erect, loosely ascending imbricate, glabrous. *Inflorescences* numerous, generally 4–8 clustered at the apex of a flowering shoot, slightly asymmetrical, the styles generally displaced adaxially; ovoid, 5,0—6,5 cm in diam.; prominently pedunculate, peduncle 2,0—3,0 cm long. *Involucral receptacle* obliquely conic-depressed to obliquely spheroidal, 1,3 cm in diam., very clearly differentiated from the peduncle. *Involucral bracts* very broadly ovate, 6,0—8,0 mm long, 6,0 mm wide, tightly imbricate, cartilaginous, apices abruptly acuminate, outer surface tomentose. *Bracteoles* obtrullate, 1,0 cm long, 0,7 cm wide, cartilaginous, apices abruptly acuminate; thickly lanate proximally. *Perianth* straight in bud, 3,0—3,5 cm long, uniformly velutinous; yellow on opening becoming deep crimson with age. *Perianth tube* 1,0—1,2 cm long, slightly laterally compressed, glabrous proximally, swollen and puberulous distally. *Perianth claws* straight, velutinous becoming tightly coiled subterminally. *Perianth limbs* 3,0 mm long, narrowly ovate, tomentose, beset with stiff erect trichomes. *Style* 4,0—5,5 cm long, very slightly adaxially arcuate; yellow, becoming crimson with age. *Pollen presenter* clavate to cylindric-obtuse, 3,0 mm long. *Hypogynous scales* hyaline, 2,0 mm long, subulate.

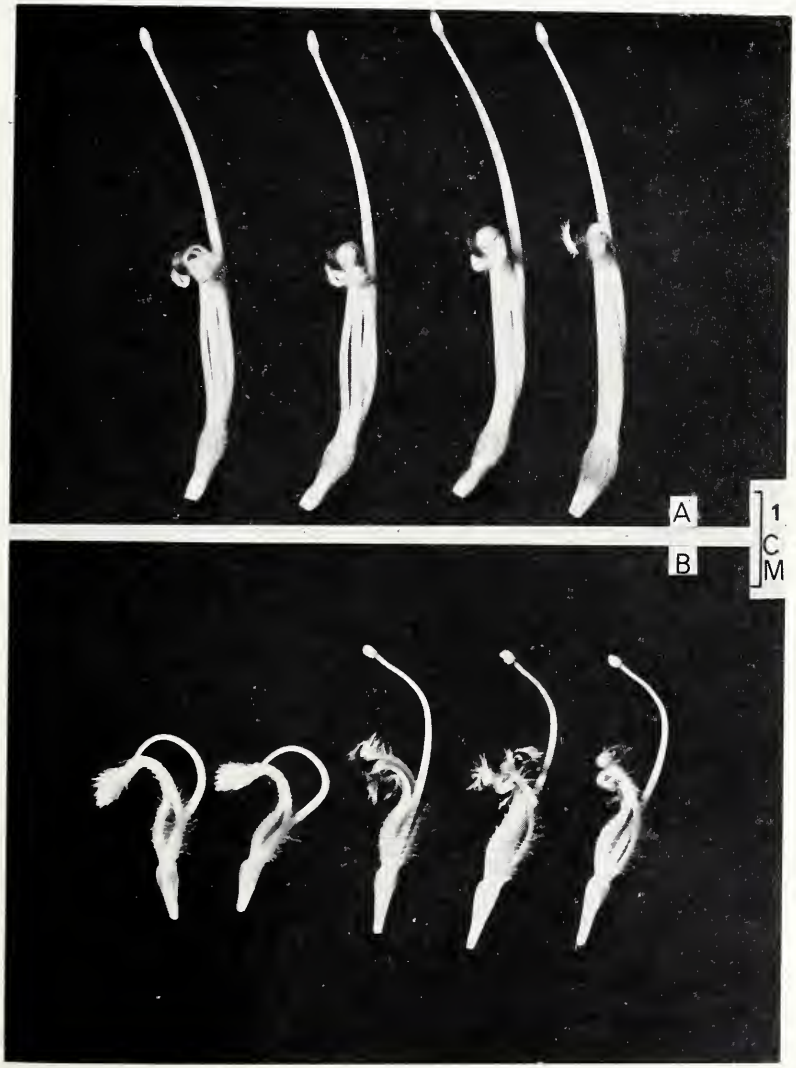


FIG. 21.
The perianth in (A) *Leucospermum erubescens* Rourke and (B) *Leucospermum utriculosum* Rourke.

Diagnostic Characters: Among the species of *Leucospermum* characterised by a distally inflated perianth tube, *L. erubescens* is distinguished by the prominently pedunculate slightly asymmetrical inflorescences, the obliquely spheroidal to conical-depressed involucral receptacle sharply differentiated from the peduncle and the uniformly velutinous perianth.

This species has already been described at varietal level as *L. attenuatum* R. Br. var. *ambiguum* Meisn. in DC. Prodr. **14:** 256 (1856). Meisner's fragmentary type consists of a single detached inflorescence and a few leaves in a capsule. The material is in the Sonder herbarium (S) and is annotated in Meisner's hand.

Type Material: Riversdale district, at Muiskraal, north slopes of the Langeberg, 18th Oct. 1966, *Rourke* 624, (holotype, NBG).

Distribution, Ecology and Biology: The range of *L. erubescens* is very limited, extending along the north slopes of the Langeberg from Muiskraal to Brandrivier with an isolated population at Warmbad on the Warmwaterberg.

Scattered populations occur sporadically along the hot northern foothills of the Langeberg in a narrow zone of Arid Fynbos, on the margin of the Little Karroo. The plants are found on rocky hills or gravel flats of Table Mountain Sandstone from 1 500–2 000 ft. A low winter rainfall of 10–15″ p.a. is experienced. Flowering takes place from August to January. On opening, the styles and perianths are pale yellow but as the flower ages both style and perianth become brilliant crimson. Up to eight inflorescences per flowering shoot are produced which persist for about two months.

Specimens Examined:

CAPE

SWELLENDAM: Near Warmbad, 30 miles from Ladismith, Nov., *Hutchinson* 1135 (K, BOL).

RIVERSDALE: Garcias Pass, on Ladismith side, Oct., *van Breda* 744 (PRE, K); Muiskraal near Garcias Pass, Oct., *Galpin* 4461 (PRE); At Muiskraal, Oct., *Williams* 544 (BOL); Slopes north of Garcias Pass, Oct., *Thorne* s.n. (SAM 38939); Top of Garcias Pass, Sept., *Garside* 4915 (K); 37 miles from Barrydale to Garcias Pass, Jan., *Marsh* 1154 (STE); Riversdale, *Muir* s.n. (SAM 3765); Muiskraal, north slopes of the Langeberg, Oct., *Rourke* 624 (NBG); North side of Garcias Pass, Aug., *Middlemost* 1706 (NBG); Garcias Pass, Dec., *Hall* 114 (NBG), *Thorne* 25 (NBG), Aug., *Barker* 5529 (NBG), Sept., *Compton* 7623 (NBG); Hills around Muiskraal, Jan., *Rourke* 246 (NBG); Brandrivier, Aug., *Williams* 1053 (NBG).

WITHOUT PRECISE LOCALITY: Africa australis, *Ecklon & Zeyher* 7, in herb. Sonder (S).

(13) **Leucospermum utriculosum** Rourke, sp. nov.

Species ramos laxos, horizontaliter patentes, emittens; receptaculo involucrali conico depresso, stigmate oviodeo, tubo perianthii infundibuliformi constrictione distali, pubscentia sericeo patulo, praecipue distinguitur.



FIG. 22.

Leucospermum utriculosum Rourke. (1) Flowering shoot; (2) inflorescense in longitudinal half section; (3) perianth and style before and after anthesis; bracteoles showing dorsal and ventral surfaces. Drawn from the type collection *Rourke* 600.

Frutex 1,0—2,0 m altus, 2,0—3,0 m latus. *Caules* ascendentes vel horizantaliter patentes. *Folia* glabra, oblanceolata-cuneata, 4,5—7,0 cm longa, 1,0—2,0 cm lata. Apices foliorum truncati, 2–5 dentati. *Inflorescentia* subglobosa depressa, 5,0—8,0 cm in diam. Receptaculum involucrale conicum depressum, 1,0 cm longum, 0,75 cm latum. *Bracteae involucrales* ovatae acutae, cartilagineae, adpressae imbricatae, cinereae sericeae, 8,0 mm longae, 5,0 mm latae. *Segmentum perianthii* obsitus trichomatibus bombycinis patulis. *Tubus perianthii* 7,0 mm longus, infundibuliformis, sed abrupte constrictus ad extremum superum; attenuatus et glaber proximalis, vesiculatus et puberulus distalis. *Stylus* 3,5—5,0 cm longus, recavus, decrescens ad apicem versus. *Stigma* conicum, ovoideum.

An erect to spreading shrub, 1,0—2,0 m tall, 2,0—3,0 m in diam., with a lax growth habit. Branches somewhat laterally to horizontally spreading, often drooping onto the ground. Single main stem, stout, branching near base; bark smooth, grey. *Flowering stems* 3,5 mm in diam. covered with a thin indumentum of fine crisped hairs, interspersed with long erect sericeous trichomes. *Leaves* glabrous, oblanceolate-cuneate, 1,0—2,0 cm wide, 4,5—7,0 cm long, tapering to a distinct petiolar region; apex truncate with 3–5 teeth. *Inflorescence* somewhat depressed globose to flattened, 5,0—8,0 cm in diam.; usually single but occasionally with up to 3 inflorescences per flowering stem; pedunculate, peduncle 1,0 cm long. *Involucral receptacle* conic-depressed, 1,0 cm long, 0,75 cm wide. *Involucral bracts* cartilaginous, closely adpressed imbricate, ovate acute, 5,0 mm wide by 8,0 mm long, sericeous, cinereous. *Bracteoles* obtrullate-cuspidate, 5,0 mm wide, 10,0 mm long, very densely lanate proximally, sericeous distally. *Perianth tube* 7,0 mm long, infundibuliform, narrowed proximally (1,0 mm in diam.), becoming swollen and inflated distally (4,0 mm in diam.), then becoming sharply constricted; glabrous proximally, puberulus distally. *Perianth claws* 2,0 cm long, beset with long, erect to spreading silky trichomes. *Perianth limbs* elliptic, 2,0 mm long, densely sericeous with long, straight, white or ferruginous trichomes. *Anthers* sessile, elliptic. *Style* 3,5—5,0 cm long, tapering and becoming somewhat incurved in the distal third. *Pollen presenter* conic ovoid 1,5—2,0 mm long, stigmatic groove terminal. *Hypogynous scales* 1,0 mm long, linear subulate.

Diagnostic Characters: L. utriculosum may be distinguished by its lax growth habit; the horizontally spreading branches; the short, conic-depressed involucral receptacle; the perianth tube narrow proximally, becoming inflated distally and then sharply constricted; the silky spreading pubescence on the perianth claws and the ovoid pollen presenter.

Type Material: Swellendam district, at Diepkloof farm, hills on the north slopes of the Potteberg, 400 ft., 24th Sept. 1966, Rourke 600 (holotype, NBG).

Thunberg made the first recorded collection of this species but he did not describe it. This specimen is in Thunberg's herbarium labelled "*Protea conocarpa* β" in his own handwriting. Although no locality was given it seems likely that Thunberg made this collection when he passed through Storms Vlei while en route for the Company's cattle post at Tyger Hoek in the early summer of 1772. Thereafter it was apparently overlooked until 1924 when Prof. R. H. Compton made a collection at McGregor.

Distribution, Ecology and Biology: The principal populations of *L. utriculosum* occur in the Robertson, McGregor, Storms Vlei areas, and along the north slopes of the Potteberg, extending as far south as the Breede River mouth.

Throughout its entire distribution range, *L. utriculosum* is restricted to dry, very rocky north facing slopes in areas receiving a winter rainfall of 10–15″ p.a., at altitudes of 200–2 000 ft. From the mouth of the Breede river along the northern slopes of the Potteberg, communities are nearly always found growing on a hard Table Mountain Sandstone-Quartzite conglomerate, often forming quite dense local stands. In the Storms Vlei—Robertson area the plants are more scattered on rocky slopes of Witteberg Quartzite as well as Table Mountain Sandstone. Some of the hills are so arid and stony and the vegetation cover so sparse that frequent veld burning has not been possible. Consequently, numerous old specimens can still be found, their main stems tightly wedged between the crevices of the boulders.

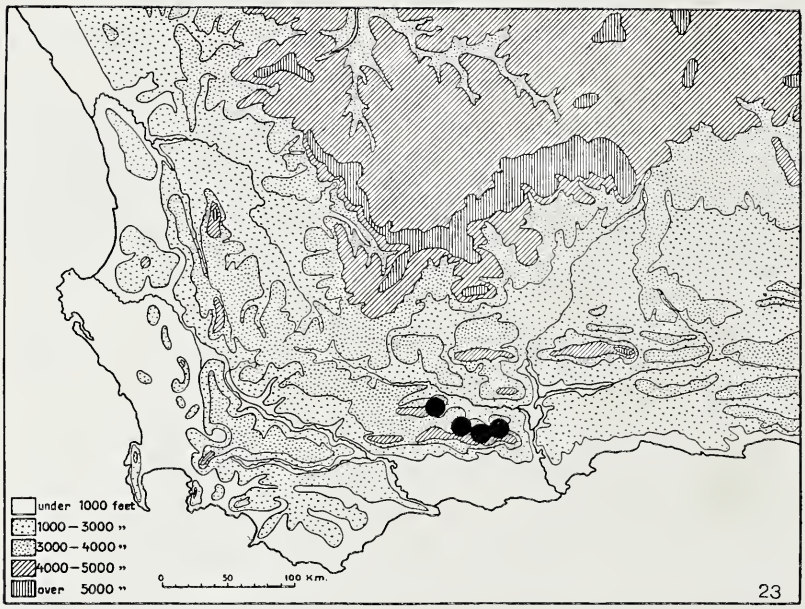
Although the peak of the flowering period is between September and November, inflorescences are produced rather erratically from May until as late as March. The style and perianth of the Potteberg populations is usually pale yellow with a green pollen presenter, while material from Storms Vlei and Robertson has orange to copper coloured perianths and styles, crimson pollen presenters and ferruginous pubescence on the perianth limbs.

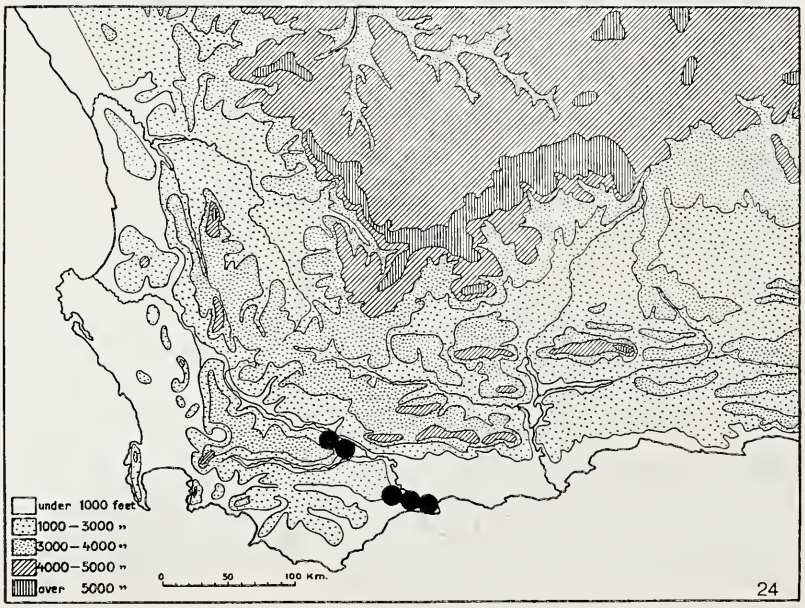
Specimens Examined:

CAPE

ROBERTSON: Schurfdeberg near Robertson, Nov., *Levyns* 9801 (CT); McGregor, Sept., *Compton* 3405 (BOL, K); Robertson, sandstone koppie, Oct., *Levyns* 2844 (CT); Storms Vlei, Sept., *Leighton* s.n. (BOL 21178); Schurfdeberg, Robertson, on top of ridge, July, *Levyns* 11307 (CT); Storms Vlei Kloof, Sept., *Compton* 5798 (BOL); On the farm Eilandia, 21 miles east of Worcester, 1 mile from main road, Nov., *Littlewood* s.n. (NBG 70451); Storms Vlei Kloof, Oct., *Rourke* 644 (NBG); Sandstone hills at McGregor, May, *Galpin* 9941 (PRE); Rocky kloof between Storms Vlei and Bonnievale, Sept., *Acock* 1741 (S).

SWELLENDAM: Potteberg north side, western end, July, *H. C. Taylor* 3656 (PRE, STE); Hamerkop, Potteberg, Oct., *Levyns* 8421 (CT); East slopes of Potteberg, April, *Levyns* 8181 (CT); Lower slopes of Potteberg, March, *Levyns* 11552 (CT); Potteberg, Jan., *Lewis* 2596 (SAM); Diepkloof farm, north slopes of Potteberg, Sept., *Rourke* 600 (NBG); Diepkloof farm, Dec., *Rourke* 281 (NBG); Albertsdal farm, Potteberg, May, *Barker* 4562 (NBG); North side of Potteberg, July, *Acocks* 22506 (PRE); Grasrug, at mouth of Breede River, Oct., *Rourke* 951 (NBG).





FIGS. 23 AND 24.
(23) Distribution of *Leucospermum erubescens* Rourke.—(24) Distribution of *Leucospermum utriculosum* Rourke.

(14) **Leucospermum spathulatum** R. Br. in Trans. Linn. Soc. Lond. **10:** 101 (1810); Phillips & Stapf in Fl. Cap. **5:** 638 (1912). Type: Africa australis, *Niven* s.n., labelled "12 Leucospermum spathulatum" in Brown's hand, holotype (BM).

Protea spathulata (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 567 (1816).

Leucadendron spathulatum (R. Br.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Leucospermum cereris Compton in J. Bot., Lond. **71:** 69 (1933). Syntypes: Without coll., Wild Fl. Show, Cape Town, Oct. 1919, sub. BOL 16283 (BOL, K); Ceres Wild Fl Show, Oct. 1927, *Compton* 3824 (BOL); Oct. 1930, *Compton* 3694 (BOL).

A prostrate, sprawling shrub with trailing stems, forming dense mats to 3,0 m in diam., seldom exceeding 30,0 cm in height. *Flowering stems* decumbent, trailing, 2,0—4,0 mm in diam., covered with a dense, short, crisped indumentum interspersed with straight, patent, trichomes; often bearing short side branches. *Leaves* obovate to spathulate, patent to subsecund, 1,4—3,0 cm long, 7,0—17,0 mm wide, apex entire, occasionally with 2-3 teeth; canescent to glabrescent, usually beset with a fine indumentum of short crisped hairs. *Inflorescences* depressed globose, 5,0—7,0 cm in diam., solitary or in groups of 2, subsessile to pedunculate, peduncle to 1,0 cm long. *Involucral receptacle* conic acute, 0,7—1,0 cm long, 5,0—7,0 mm wide. *Involucral bracts* ovate acute-acuminate, tightly imbricate, cartilaginous tomentose, 7,0 mm long, 4,0 mm wide. *Bracteoles* ovate acuminate, thickly lanate proximally, 7,0 mm long, 4,0 mm wide, clasping the perianth. *Perianth* strongly adaxially arcuate, deep orange to crimson. *Perianth tube* 8,0 mm long, narrowed proximally, becoming ventricose and strongly inflated distally on the adaxial surface. *Perianth claws* strongly recurved subterminally, sericeous to villous. *Perianth limbs* ovate acute 3,0 mm long, sericeous. *Style* 3,0—4,0 cm long, tapering subterminally, upper third bent adaxially, almost at right angles. *Pollen presenter* cylindric obtuse, 2,0 mm long, stigmatic groove slightly adaxial. *Hypogynous scales* 3,0—4,0 mm long, linear subulate.

Diagnostic Characters: L. spathulatum is distinguished from those related species having a prostrate growth habit, conic involucral receptacle and inflated perianth tube by its usually entire, oblong to spathulate leaves, 1,4—3,0 cm long, beset with a short crisped indumentum (of varying density), and the strongly arcuate style, 3,0—4,0 cm long.

An unlocalised collection made by Niven is the earliest record of this species and serves as the type of *L. spathulatum* R. Br. *Leucadendrum bellidifolium* Salisb. ex Knight, published a year earlier, was considered by Phillips and Stapf

to be synonymous with *L. spathulatum* R. Br. However, the type description was based on plants flowering in the conservatory of the Marquis of Blandford which had been raised from seed collected by Niven. As Niven's seed was unlocalised and no type material appears to have been preserved, the name *L. bellidifolium* cannot be typified with any certainty as the description could equally apply to this or several other decumbent species. For the present, *L. bellidifolium* is best regarded as a species insufficiently known.

Distribution, Ecology and Biology: The range of *L. spathulatum* extends from the Middelberg Plateau in the Cedarberg, southwards to the Cold Bokkeveld mountains, with an outlying population on Sawedge Peak near Worcester.

This species is most abundant in the Cedarberg where populations occur in dry, rocky exposed positions between 4 500 and 5 500 ft. A winter rainfall of up to 35″ p.a. is experienced with occasional snowfalls in winter. The stout main stems are rooted in rock crevices and produce horizontally spreading branches which sprawl over the adjacent ledges or large slabs of Table Mountain Sandstone. Mature plants may develop into mats up to 3,0 m in diam. The matted growth habit is due to the development of short interlocking side branchlets on the flowering stems. In this respect *L. spathulatum* differs from the related *L. profugum* in which the flowering stems are straight or looped and are rarely branched. The scarlet to crimson inflorescences are produced between September and January but mainly towards the end of October.

Specimens Examined:

CAPE

CLANWILLIAM: Archberg, Cedarberg, Dec., *Esterhuysen* 18122 (BOL, NBG, PRE); Wolfberg, Dec., *Vogts* 84 (STE, PRE); Wolfberg, Cedarberg Plateau, Dec., *Esterhuysen* 22457 (BOL, K, PRE); Cedarberg, Nov., *Stokoe* 8060 (BOL); Middelberg Plateau, Dec., *Levyns* 10819 (CT); South slopes of Sneeuwberg, Oct., *White* s.n. sub. SAM 20949 (SAM); Square Peak, above De Riff, Jan., *Rycroft* 2676 (NBG); Matjies River, Oct. & Jan., *Wagener* 266 (NBG); Gabriel's Pass, rocky s.w. slopes, Nov., *Kruger* 934 (NBG).

CERES: Gideon's Kop, Oct., *Esterhuysen* 31623 (BOL); Gideon's Kop, April, *Esterhuysen* 27219 (BOL); On the farm Rosendal, east of Bokkeveld Sneeuwkop, March, *White* s.n. sub. SAM 45892 (SAM); Blaauwkop, Cold Bokkeveld, Oct., *Esterhuysen* 27904 (BOL); Gideon's Kop, Oct., *Rourke* 668 (NBG).

WORCESTER: Sawedge Peak, east of Keeromsberg, along summit of a rugged east ridge, Sept., *Esterhuysen* 31163 (BOL).

(15) **Leucospermum profugum** Rourke, sp. nov.

Inter *Leucospermum* species caulibus decumbentibus, receptaculis involucralibus conicis, et perianthiis infundibuliformibus, *L. profugum* a stylo 4,5—6,2 cm longo, foliis obovatis vel oblanceolatis, 2,9—5,2 cm longis, glabris vel glabratis 3–4 dentibus apicalibus, distinguitur.

Frutex decumbens. *Caules* pauci, serpentes, 2,0—4,0 m longi; caudicem nodosum expositum exorientes. *Folia* oblanceolata vel obovata, 2,9—5,5 cm longa, 0,6—1,8 cm lata, glabra vel glabrata, apicem 3–4 dentatum. Folia plerumque secunda vel subsecunda, saepe retrorsa apicem versus caulium. *Inflorescentiae* solitariae, depressae ovoideae, 9,0—12,0 cm in diam.; pedunculus 3,0—3,5 cm longus, a caule ad angulum 90° portatus. *Receptaculum involucrale* conicum acutum, 2,0—2,5 cm longum, 1,0—1,3 cm latum. *Bracteolae* late obovatae, abrupte acuminatae, 8,0—9,0 mm latae, 11 mm longae, cartilagineae, dense lanatae proximales. *Perianthium* 3,5—4,0 cm longum, salmoneum. Tubus perianthii infundibuliformis, 1,5 cm longus, glaber proximalis, puberulus distalis; adaxialis carinatus. *Stylus* adaxialis arcuatus, 4,5—6,5 cm longus. *Stigma* anguste ovoideum vel conicum acutum.

A decumbent shrub with a stout, exposed, woody rootstock, 4,0—12,0 cm in diam., from which arise several stout, unbranched, trailing stems, 2,0—4,0 m in length. *Basal branches* stout and woody, 2,0—3,0 cm in diam., usually bare or covered with corky bark. *Flowering stems* often looped or bowed with the inflorescences arising at right angles to the stem. *Leaves* oblanceolate to obovate, 2,9—5.5 cm long, 0,6—1,8 cm wide, glabrous to glabrescent, the young leaves with a sparse indumentum of short crisped hairs, soon becoming glabrous; apex rounded to subtruncate with 3–4 teeth; leaves usually secundly arranged, often reflexed and bent backwards. *Inflorescences* solitary, depressed ovoid, 9,0—12,0 cm in diam.; peduncle 3,0—3,5 cm long, arising at right angles to the stem. *Involucral receptacle* conic acute, 2,0—2,5 cm long, 1,0—1,3 cm wide. *Involucral bracts* lanceolate acute, 5,0—7,0 mm long, cartilaginous, softly tomentose. *Bracteoles* broadly obovate to cordate, 8,0—9,0 mm wide, 11 mm long, cartilaginous, thickly lanate proximally; apex abruptly acuminate, 4,0—5 mm long. *Perianth* 3,5—4,0 cm long, yellowish orange, becoming deep reddish orange to salmon pink with age. *Perianth tube* infundibuliform, 1,5 cm long, tapering and glabrous proximally, becoming greatly inflated and puberulous distally, 1,0—1,5 mm in diam. proximally, 3,5—4,0 mm in diam. distally; abaxial surface keeled. *Perianth limbs* lanceolate acute, 4,0 mm long, 1,5 mm wide beset with a hispid ferruginous indumentum. *Style* curved adaxially, 4,5—6,2 cm long, tapering towards the apex. *Pollen presenter* narrowly ovoid to conic acute, 1,0 mm long. Stigmatic groove oblique, adaxially placed. *Hypogynous scales* linear subulate, orange, 4,0—5,0 mm long.

Diagnostic Characters: Among the prostrate species of *Leucospermum* with a conic involucral receptacle and infundibuliform perianth tube, *L. profugum* is distinguished by its long style, 4,5—6,2 cm in length and the large (2,9—5,2 cm long) glabrous to glabrescent, obovate to oblanceolate leaves, usually with 3 or 4 teeth at the apex.

Type Material: Piketberg, half a mile south of the summit of Versveld's Pass, 20th Oct., 1968, *Rourke* 1141, (holotype, NBG).

Distribution, Ecology and Biology: This species is confined to the southern extension of the Piketberg, where it has been recorded between Versveld's Pass and Aasvoelkop, along the south eastern escarpment, between 1 200 ft. and 2 500 ft. Miss G. Edwards made the first recorded collection of *L. profugum* in 1914 on the Piketberg.

L. profugum has a distinctive growth habit unlike most other decumbent species in the genus. The plants produce only a few main stems, up to 4 m in length which trail over the rocks and surrounding vegetation. These stems arise from a gnarled, woody rootstock, usually exposed and wedged between the cracks of large boulders. The rootstocks and basal stems develop a tough corky bark which results in the plants being fairly fire resistant. For the greater part of their length the main stems are devoid of leaves and tend to develop adventitious roots where they are in close contact with the soil.

All the observed populations were found to occur in well drained situations, on rocky outcrops or on small koppies of Table Mountain Sandstone. The associated vegetation consists mainly of low *Restionaceae*, *Leucadendron glaberrimum*, *Rhus africana* and *Diosma vulgaris*. Flowering occurs from late September until December.

Specimens Examined:

CAPE

PIKETBERG: Top of Piketberg mountain, Sept., *Barker* 10347 (NBG); Piketberg, 1 200 ft., Sept., *J. Krige* s.n. (STE 10546); Piketberg, Nov., *Edwards* s.n. (BOL 14444); Top of Piketberg mountain, Sept., *Martin* 883 (NBG); Piketberg mountain, Aug. (in bud), *Rourke* 541 (NBG); Piketberg mountain, Nov., *Martin* 900 (NBG); Half a mile south of the summit of Versveld's Pass, Oct., *Rourke* 1141 (NBG); Piketberg mtn. top, Oct., *Barker* 10347 (NBG).

Sect. 4. BREVIFILAMENTUM Rourke, Sect. nov.

Folia linearia-oblonga vel elliptica-ovata, saepe basaliter cordata. Receptaculum involucrale conicum vel peranguste conicum acutum. Stigma ovoidea vel oblique ovoidea vel unguliforme. Antherae subsessiles; filamentum 1,0—2,0 mm longum.

Leaves linear-oblong to elliptic-ovate, often cordate at base. Involucral receptacle very narrowly conic acute. Pollen presenter ovoid, obliquely ovoid or obliquely turbinate (hoof shaped). Anthers subsessile; filament 1,0—2,0 mm long.

Type: *L. vestitum* (Lam.) Rourke

(16) **Leucospermum vestitum** (Lam.) Rourke in Jl S. Afr. Bot. **33:** 266 (1967). *Protea vestita* Lam., Encycl. Meth. Bot. Illustr. **1:** 239 (1792). Type: Cap. b. Spei, *Joseph Martin* s.n., holotype in herb. Lamarck (P–LA). *Leucadendrum ellipticum* (Thunb.) Salisb. ex Knight sensu Knight, Cult. Prot.: 53 (1809), according to specimen cited. [Jackall Flyberg, *Niven* 53(K).]

Leucospermum medium R. Br. in Trans. Linn. Soc. Lond. **10:** 97 (1810). Type: Specimen labelled "4 Leucospermum medium africa australis Oldenland" in Brown's hand, taken as type (BM).
Protea media (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 566 (1816).
Leucospermum incisum Phillips in Kew Bull. **1910:** 332 (1910); Phillips in Fl. Cap. **5:** 620 (1912). Type: Breede river valley near Darling Bridge, *Bolus* 5235, holotype (K), isotype (BOL).

A stiffly erect to spreading shrub to 2,5 m in height, up to 3,0 m in diam., with a single stout main stem; bark smooth, grey. *Flowering stems* 0,5—0,8 cm in diam., stiffly erect to horizontally spreading, thinly puberulous. *Leaves* oblong to elliptic to narrowly ovate, 5,0—7,5 cm long, 1,0—3,0 cm wide, glabrous, sessile, truncate or cordate at base, apex entire or with 2–4 teeth; loosely imbricate. *Inflorescences* ovoid to globose, 7,0—9,0 cm in diam., usually borne singly. *Involucral receptacle* very narrowly conical-acute, 4,0—5,0 cm long, 0,75—1,0 cm wide. *Involucral bracts* broadly ovate-acute to acuminate 1,0—1,5 cm long, 0,5—1,0 cm broad, loosely patent, membranous, glabrous, pale green and shiny in fresh state, margins ciliate. *Bracteoles* ovate acuminate, membranous, clasping the perianth tube, 1,5 cm long, 0,5—0,7 cm broad, glabrous, or minutely puberulous, margins ciliate. *Perianth* 3,5 cm long, orange on opening becoming brilliant carmine with age. *Perianth tube* 6,0 mm long, glabrous, cylindric becoming slightly compressed laterally. *Perianth claws* sigmoid after anthesis, coiled subterminally, median adaxial claw glabrous, margins of the two lateral adaxial claws beset with erect, straight silky trichomes, the abaxial claw densely beset with straight silky trichomes. *Perianth limbs* ovate 4,0—5,0 mm long, 1,0 mm wide, beset with long, straight silky trichomes. *Anthers* ovate 3,0 mm long, subsessile, filament 1,0 mm long. *Style* 5,0—6,0 cm long, the upper third adaxially arcuate. *Pollen presenter* obliquely ovoid acute, 3,0 mm long, stigmatic groove in a raised terminal papilla. *Hypogynous scales* 1,5—2,0 mm long, linear, obtuse, cream.

Diagnostic Characters: The glabrous, membranous, loosely patent involucral bracts, the very narrowly conic acute involucral receptacle, the glabrous oblong leaves and obliquely ovoid pollen presenter distinguish *L. vestitum* from related species.

The type of *Protea vestita* Lam. is a specimen collected at the Cape by Joseph Martin, probably in 1788. Martin studied at the Paris Botanic Garden and was later sent to Mauritius by the French government. He proceeded to Mahe and Malabar and was eventually posted to Cayenne in French Guiana as government botanist and director of the botanic garden. There is apparently no published

record of his visit to the Cape which probably took place in 1788 while en route for Mauritius. Nevertheless, it is evident from the collection of Cape Proteaceae which he sent to Lamarck that he penetrated at least as far as the upper Breede River valley between the Worcester-Hex river area and Tulbagh.

Distribution and Ecology: The present range of *L. vestitum* extends from Heerenlogementberg in the north, southwards through the districts of Clanwilliam, Ceres, Piketberg and Tulbagh to the northern end of the Breede River valley, a few miles north of Worcester.

Three collections of this species have been made on the Cape Peninsula but it has not been observed growing wild there since 1886. A specimen was collected by Marloth on Table Mountain at 500 ft. in November 1884. Material was also collected by C. A. Fairbridge on the eastern slopes of Lion's Head at 200 ft. in October 1886 and by Zeyher above Judge Menzies' estate at Green Point although this latter collection is undated. (Mr. Justice William Menzies purchased 18 morgan of land at Sea Point on which he built his home, Sea Point House. The site of this house was subsequently occupied by the Queens Hotel and more recently, the Hotel President.)

In the light of present day distribution records these collections appear spurious. Nevertheless, the fact that all three were made by reliable collectors and in fairly close proximity to each other, suggests that *L. vestitum* actually did occur naturally near Cape Town but has since been exterminated there due to urban expansion. It is also extinct now on Paarl mountain.

L. vestitum appears to have no special ecological requirements apart from a dry, well drained position on a rocky slope of Table Mountain Sandstone, between 200 and 4 000 ft., usually in north or west facing situations. This species is very tolerant of dry conditions as it frequently occurs associated with arid fynbos in regions receiving a winter rainfall as low as 10″ p.a.

Plants from the Tulbagh valley often tend to have a stiff upright growth habit with erect stems while those from more northerly localities develop into rather sprawling shrubs. Flowering commences as early as July in warm localities and continues until January, with a peak in October and November.

Specimens Examined:

CAPE

VAN RHYNSDORP: Heerenlogementsberg, N.E. aspect, Sept., *H. C. Taylor* 3944 (STE, PRE, NBG); West slope of Torenberg, Heerenlogement, July, *Barker* 9887 (NBG); Heerenlogementsberg, July, *Compton* 10981 (NBG).

CLANWILLIAM: Lambertshoekberg, Sept., *Maguire* 421 (NBG); Middelberg, Cedarberg, Dec., *Kerfoot* 6146 (NBG); Algeria, Cedarberg, Sept., *Siaens* s.n. (NBG 81913); Ridge S.E. of Uitkyk peak, Jan., *H. C. Taylor* 2307 (NBG); Uitkyk Pass, Sept., *Compton* 8477, 7009 (NBG); Grey's Pass, Oct., *Acocks* 19823 (PRE, NBG, K); Uitkyk Pass, Dec., *Salter* 5092 (BM); Groot

Kliphuis, 8 miles S. of Clanwilliam, Dec., *Leipoldt* 3514 (PRE); Pakhuis Pass, Nov., *Galpin* 11086 (PRE, K); Mountains at Jackals Vlei, *Niven* 53 (K); Upper slopes of Pickeniers Pass, Nov., *Pearson* 5137 (K); Krakadouw heights, Cedarberg, Oct., *Pocock* 577 (STE); Grey's Pass, Oct., *Levyns* 1375 (CT, K); Lambertshoekberg, Aug., *Compton* 5495 (NBG, BOL); North side of the Cedarberg at Heuning Vlei, Jan., *Esterhuysen* 21131 (BOL, PRE); Clanwilliam, hills S.E. of Keerom, Nov., *Pillans* 8820 (BOL); Blaauwberg 3 500–4 000 ft., 24/11/1828, *Drège* 8056 (P, G, K, BM); Blaauwberg 3 500–5 000 ft., 4/1/1831, *Drège* s.n. (P); Pikeniers Kloof Pass, Aug., *Rourke* 544 (NBG).

PIKETBERG: In sumo monte Piketberg, Oct., *A. Bolus* 13636 (BOL); Western slopes of Cardouw Pass near Porterville, Sept., *Lewis* 3676 (SAM); Mountain at "The Rest", Piketberg, Sept., *Gillet* 3727 (BOL); Hills N.W. of Moutons Vlei, Nov., *Pillans* 7471 (BOL); Piketberg mountain, Nov., *Martin* 1165 (NBG); Cardouw Pass, Nov., *Compton* 23032 (NBG); Kapiteins Kloof, Piketberg, Sept., *Pillans* 7670 (BOL); Top of mts. at back of "The Rest", Sept., *Howes* 201 (PRE, BR); Bosch Kloof, Piketberg, Sept., *Compton* 9500 (NBG); Heuningberg, Piketberg, Nov., *Acocks* 23429 (PRE), *H. C. Taylor* 5558 (PRE); Piketberg, Jan., *Theiler* 9 (PRE).

CERES: Ceres Rd., Oct., *Marloth* 1982 (PRE); Ceres, Nov., *Meebold* 12421 (NY).

TULBAGH: Tulbagh Rd., Sept., *Schlechter* 8997 (PH, GRA, NH, S, G, K, BM, PRE); Roodezand mts., Oct., *Andreae* 614 (PRE, STE); Breede river valley near Darling Bridge, Nov., *Bolus* 5235 (BOL, K); Between Tulbagh and Wolsely, Feb., *Rourke* 9 (BOL); Mountains around The Tulbagh Waterfall, Oct., *McOwan* 904 (BOL, SAM, G, BM, K); In ericetis prope, Tulbagh, Nov., *Bolus* 5236 (BOL, K); In the Winterhoek mts., Tulbagh, Nov., *Pappe* s.n. (SAM 19620); Tulbagh Rd., Sept., *Schlechter* 8992 (BR, Z); Roodesandberg, Sept., *Compton* 6670 (NBG); Michells Pass, Jan., *Wasserfall* 780 (NBG); Ceres Rd., below Michells Pass, *Guthrie* 3404 (NBG); Leeuriver, Tulbagh valley, Sept., *Rourke* 1120 (NBG); On the road to Goedgevonden, Dec., *Vogts* 60 (PRE, STE); Below homestead of "The Waterfalls", Tulbagh, *Phillips* 524 (PRE, K); Gravelly places between Tulbagh & Michells Pass, Dec., *Acocks & Hafstrom* 2104 (PRE).

WORCESTER: Near Breede River, Worcester, Jan., *Mund* s.n. (B); Hex River, 1 000–1 500 ft., 12/9/1826, *Drège* s.n. (P); Die Eike near Breede River station, Oct., *van Breda* 997 (PRE); Botha station, between Wolsely and Worcester, Oct., *Rourke* 1140 (NBG).

PAARL: Paarl mountain, *Tyson* s.n. (SAM 19618).

CAPE TOWN: On the eastern hills of Lion's Head, 200 ft., Oct. 1886, *C. Fairbridge* 7036 (BOL); In clivis montis Tabularis, Nov. 1884, *Marloth* 341 (PRE); Stony area at Greenpoint above Menzies estate, Oct., *Zeyher* s.n. (BOL).

WITHOUT PRECISE LOCALITY: Cape of Good Hope, *Verreaux* s.n. (NY, FI); C.B.S., *Thunberg* in herb. *Bergius* (SBT) Prom. Bona Spei, *J. Roxburgh* s.n. (G).

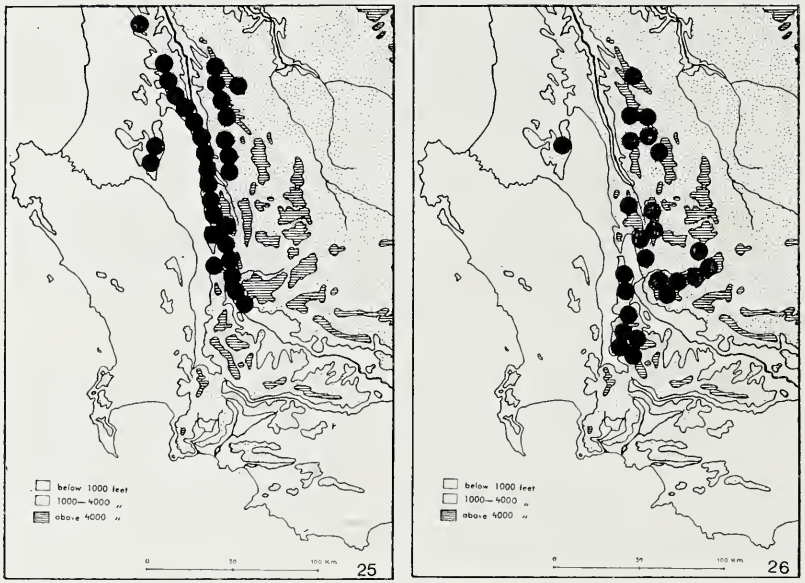
(17) **Leucospermum tottum** (L.) R. Br. in Trans. Linn. Soc. Lond. **10:** 97 (1810); Phillips & Stapf in Fl. Cap. **5:** 621 (1912); Vogts in Flower. Pl. S. Afr. **35:** t. 1380 (1962).

Protea totta L., Mant. Alt.: 191 (1771). Type: "Roode Zand mountains, 3 ft., whole thickets, fl. August", *Tulbagh* s.n. sheet no. 116·35 (LINN).

Protea lotta L., Poir. in Lam., Encycl. Meth. Bot. **5:** 644 (1804), "totta".

Leucadendron tottum (L.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Leucadendrum horizontale Salisb. ex Knight in Knight, Cult. Prot.: 53 (1809),—nom. superfl.



FIGS. 25 AND 26.
(25) Present distribution of *Leucospermum vestitum* (Lam.) Rourke.—(26) Distribution of *Leucospermum tottum* (L.) R. Br.

An erect, much branched shrub 1,0—2,0 m in diam., with a single main stem and somewhat horizontally spreading branches. *Flowering stems* held horizontally, 5,0—7,0 mm in diam., thinly pilose to glabrescent, reddish tinted. *Leaves* sessile, glabrous, lanceolate acute to oblong linear, occasionally cordate at base, 0,5—1,5 cm wide, 2,5—6,0 cm long; apex usually entire, occasionally with 2 or 3 teeth; leaves widely spaced, patent. *Inflorescences* usually solitary, broadly depressed conic, becoming discoidal on opening, 9,0—15,0 cm in diam; pedunculate, peduncle 2,0—3,0 cm long. *Involucral receptacle* narrowly conic, 3,0—4,0 cm long, 4,0 mm broad. *Involucral bracts* broadly ovate to ovate acuminate 4,0—7,0 mm wide, 1,0—1,5 cm long, expanded into 2 membranaceous wings in the proximal half; glabrous but with ciliate margins, patent to very loosely imbricate. *Bracteoles* broadly ovate, 15,0 mm long, 8,0 mm wide, softly membranaceous, lanate proximally, puberulous to glabrous distally, apices acuminate. *Perianth* 4,0—4,5 cm long, pale pink. *Perianth tube* 7,0 mm long, glabrous to very sparsely pilose, slightly laterally compressed. *Perianth claws* 1,0 mm wide, thinly pilose, the 3 adaxial claws fused into a sheath, becoming

very tightly coiled on opening in the subterminal region. *Perianth limbs* ovate, 3,0 mm long, 1,5 mm wide, dull carmine to brownish, sparsely tomentose. *Anthers* subsessile, ovate to lanceolate, 2,0 mm long. *Style* 5,0 cm long, slightly adaxially curved, straightening as the inflorescence ages, eventually projecting at right angles to the receptacle. *Pollen presenter* ovoid acute, 1,0—1,5 mm in diam., adaxial surface oblique, stigmatic groove terminal. *Hypogynous scales* subulate linear, 2,0 mm long, hyaline.

Diagnostic Characters: L. tottum is distinguished by its narrowly lanceolate to linear-oblong, usually entire leaves, the glabrous, loosely imbricate involucral bracts, the ovoid pollen presenters and the nearly straight styles which become patent to horizontally spreading at maturity.

It is probable that the first collection of *L. tottum* was made by Auge. Specimens from this collection were sent to Linnaeus in about 1769 by Tulbagh, then Governor of the Cape, who reported that it occurred in the Roodezand mountains in "whole thickets".

Although there has been some uncertainty regarding the precise meaning of the epithet "tottum", Houttuyn's suggestion that it had been derived from the word Hottentot, thereby implying that it was a native of the Cape, is the most logical explanation. [Houttuyn, *Nat. Hist. Deel* 2, **4**: 108 (1775)].

L. tottum (L.) R. Br. var. *glabrum* Phillips is regarded by the present author as a putative hybrid between *L. tottum* and *L. vestitum* and is discussed in the chapter on hybrids.

Distribution and Ecology: The range of *L. tottum* extends from as far north in the Cedarberg as Ezelbank, southwards through the Cold Bokkeveld, Ceres, Tulbagh, Worcester and Paarl mountains to Villiersdorp.

Apart from a few dense stands on the Zuurvlakte near Tulbagh and near Villiersdorp, *L. tottum* tends to be a rather solitary species. Scattered individuals or small groups are widely dispersed in rugged mountainous country at elevations of 1 000 to 6 000 ft. The range of habitats occupied may vary from hot, dry north facing positions in the Cedarberg, receiving 15–20″ p.a. to cool, moist south facing slopes where the annual rainfall may be up to 60″ p.a. Flowering takes place from September to January.

Specimens Examined:

CAPE

CLANWILLIAM: Grootberg, south west slopes, Dec., *Esterhuysen* 4173 (BOL, PRE); Duivelskop, Cedarberg, Jan., *Stokoe* s.n. sub. SAM 56567 (SAM); Top of Middelberg Pass, Oct., *Acocks* 19855 (PRE, K); Top of Oliphants River mountains behind Warm Baths, Nov., *Stephens* 6862 (K); Ezelbank, Oct., *Thode* 2063 (PRE); Kleinfontein, Clanwilliam, Dec., *Gentry* 19018 (PRE).

PIKETBERG: Piketberg mountain, Sept., *Kriege* s.n. sub STE 10548 (STE).

CERES: Matroosberg, Dec., *Marloth* 2271 (STE); Kleyn vlei, Koue Bokkeveld, Jan., *Schlechter* 10206 (PH, B, BR, Z, BM, K, PRE, S); Koue Bokkeveld, in saxosis prope Sandrivier, Jan., *Schlechter* 10116 (GRA, BOL); Elands Kloof, Dec., *Levyns* 8131 (CT); West base of the Schurfteberg, Nov., *Pillans* 9705 (BOL); South slopes of Castle Rocks, Dec., *Esterhuysen* 14697 (BOL, PRE); Near Laaken vlei, Matroosberg, Nov., *Phillips* 2130 (SAM); Ceres mountains, Dec., *Marloth* 13363 (PRE); Matroosberg, Sand drift kloof, Jan., *A. Bolus* 6369 (BOL).

TULBAGH: Tulbagh, Zuurvlakte, Nov., *Kling* s.n. sub STE 9013 (STE); Witsenberg, summit of eastern slopes, Dec., *Andreae* 147 (STE); In montibus juxta Tulbagh waterfall, *MacOwan* 2505 (NH, PRE, K, Z); In monte Witsenberg, Dec., *Zeyher* 1462 (PRE, G, S); Witsenberg Oct., *Marloth* 10704 (PRE).

PAARL: Bain's Kloof, Oct., *Hastig* s.n. sub. STE 30015 (STE); Lower slopes of Seven Sisters mountains, Jan., *Esterhuysen* 18325 (BOL); Bailey's Peak, Jan., *Esterhuysen* 8530 (BOL); Bottom of Du Toits Kloof, Dec., *Rourke* 56 (BOL, NBG); Paarl side of Du Toits Kloof, Dec., *Gill* 26 (NBG); Du Toits Kloof, Nov., *Walters* 143 (NBG); Du Toits Kloof Pass near Paarl, *Werdermann & Oberdieck* 735 (K, PRE); Bain's Kloof, Nov., *Thorne* s.n. sub. SAM 46537 (SAM); Du Toits Kloof mountains, between Dal Josephat and Wagenmakers vallei, 18/1/1828, *Drège* s.n. (P, S, SAM); Du Toitskloof Berg, 30/11/1827, *Drège* 1467 (P).

WORCESTER: Louwshoek mountain, Nov., *Stokoe* s.n. sub SAM 58934 (SAM); Ad latera montium Drakensteen prope Du Toits Kloof, Oct., *MacOwan* no 776 in Herb. Norm. Austro. Afric. (BOL, SAM, GRA, NH, K, BM, BR, G); Worcester, Sept., *T. Cooper* 1397 (K, BM NY, Z, BOL, NH, PRE); Worcester, Oct., *Fine* 996 (PRE).

CALEDON: Stettynsberg, lower south west slopes, Dec., *Esterhuysen* 11160 (BOL); Villiersdorp, *Middlemost* s.n. (GRA); On the farm Bo Radyn, 2 miles N.W. of Villiersdorp, *Littlewood* s.n. sub NBG 77988 (NBG); Villiersdorp, summit of Elands Kloof, Nov., *M. G. Gillet* 725 (K); Caledon, Nov., anno 1837, *Verreaux* s.n. (G).

WITHOUT PRECISE LOCALITY: Prom. bon. spei, 1773, *Oldenburg* s.n. (BM); C. b. sp., *Wannan* s.n. in herb. Bergius (SBT)]; Cap. b. sp., *Thunberg* s.n. in herb. Bergius (SBT)].

(18) **Leucospermum lineare** R. Br. in Trans. Linn. Soc. Lond. **10:** 96 (1810); Phillips & Stapf in Fl. Cap. **5:** 622 (1912); Phillips in Flower Pl. S. Afr. **15:** t. 572 (1935). Lectotype: Cape of Good Hope, *Masson* s.n. (BM).

Leucadendron lineare Burm. f., Fl. Cap. Prodr.: 4 (1768). Type: Cape of Good Hope, *Oldenland* in herb. Burman (G).

Protea linearis Thunb., Diss. Prot.: 33, t.4 (1781),—non *P. linearis* Houtt., Nat Hist. Deel 2, **4:** 116 t. 19 f. 2 (1775). Type: Cape of Good Hope, *Thunberg* s.n. sheet 2938 in herb. Thunberg (UPS).

Leucadendrum fallax Salisb. ex Knight in Knight, Cult. Prot.: 52 (1809), — nom. supfl.

Leucospermum lineare R. Br. var. *calocephalum* Gandoger in Bull. Soc. bot. Fr. **48:** 94 (1901). Type: In lapidosis ad Mostertsberg prope Mitchells Pass, *MacOwan* 2839, Herb. Norm. Austro. Afric. no. 777, holotype in herb. Gandoger (LY).

Leucospermum calocephalum (Gandoger) Gandoger & Schinz in Bull. Soc. bot. Fr. **60:** 53 (1913). Type: As above.

An erect to sprawling shrub to 2,0 m in height, 3,0—4,0 m in diam. if sprawling. *Flowering stems* erect or horizontally spreading, glabrous, 2,0—5,0 mm in diam. *Leaves* linear, flat or very broadly canaliculate with involute margins; 4,0—10,0 cm long, 2,0—7,0 mm wide, glabrous; loosely ascending or occasionally subsecund; apex entire or 2–3 dentate. *Inflorescences* depressed ovoid, 6,0—9,0 cm in diam., usually solitary but occasionally in groups of 2 or 3; pedunculate, peduncle 1,0—4,0 cm long. *Involucral receptacle* very narrowly conic acute, 2,0—3,0 cm long, 3,0—5,0 mm wide. *Involucral bracts* ovate acute, 1,5 cm long, 1,0 cm wide, imbricate, cartilaginous, tomentose on outer surface, margins densely ciliate. *Bracteoles* ovate acute 1,0 cm long, 5,0—6,0 mm wide, cartilaginous, thickly lanate proximally. *Perianth* 3,0 cm long, sigmoid on opening, pale yellow to orange. *Perianth tube* 7,0—8,0 mm

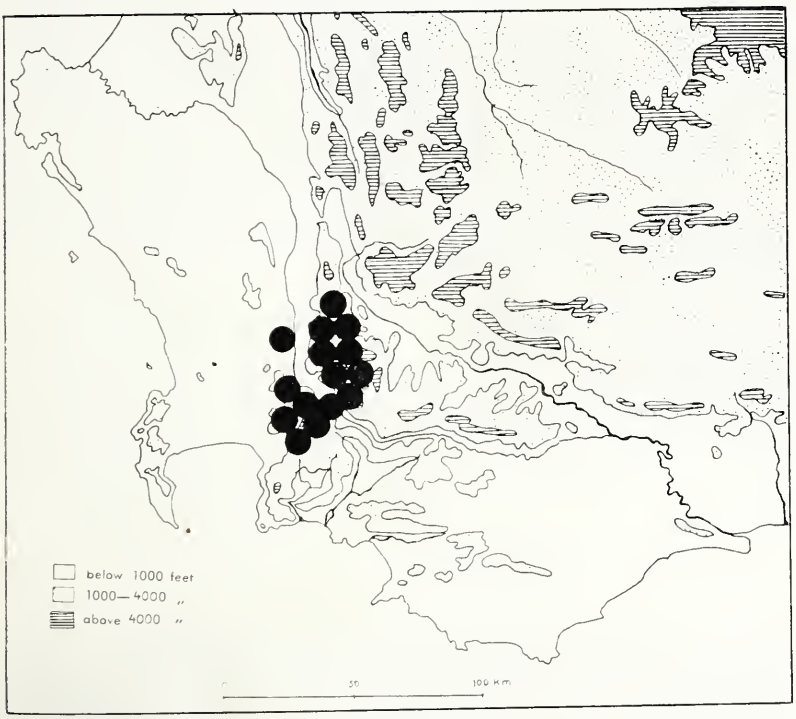


Fig. 27.
Distribution of *Leucospermum lineare* R. Br.

long, slightly ventricose; glabrous distally. *Perianth claws* coiled subterminally, villous. *Perianth limbs* lanceolate, 3,0 mm long, sparsely hispid. *Anthers* subsessile. *Style* 5,0—5,5 cm long strongly adaxially arcuate distally. *Pollen presenter* ovoid, acute, 1,5 mm long, stigmatic groove terminally oblique. *Hypogynous scales* linear subulate, 2,0 mm long.

Diagnostic Characters: L. lineare is distinguished from all other species of *Leucospermum* with subsessile anthers by its glabrous linear leaves, either flattened or with involute margins.

N. L. Burman's name *Leucadendron lineare* is the earliest validly published name to have been applied to this species but his epithet "lineare" cannot be taken up as Brown had already used the binomial *Leucospermum lineare* in 1810, citing *Protea linearis* Thunb. but not *Leucadendron lineare* Burm. f. Thunberg's name *P. linearis* is, however, illegitimate as it is a later homonym of *P. linearis* Houtt. Therefore, a Masson specimen which was examined and annotated by Brown in the Banks collection (BM), upon which his *L. lineare* was probably based, has been chosen as the lectotype of *Leucospermum lineare* R. Br.

Distribution and Ecology: The range of *L. lineare* extends from Bain's Kloof in the north, southwards to the Paarl, Klein Drakenstein and French Hoek mountains, and to Jonkershoek. Two forms are known of which the horizontally sprawling form with golden yellow perianths and styles is the most widespread. At Assegaaibos Kloof, French Hoek, a more erect form occurs locally with an upright habit and deep orange perianths and styles.

Most populations of *L. lineare* occur in mountainous country between 1 000 and 3 000 ft. above sea level where a winter rainfall of 30–50″ p.a. is experienced. Particularly notable is the fact that this species grows almost exclusively on soils derived from weathered Cape Granite. This breaks down to form a heavy gravelly clay. At a few places where *L. lineare* occurs on Table Mountain Sandstone, it is generally underlain by weathered granite. Flowering takes place erratically from July to January but chiefly during September and October.

Specimens Examined:

CAPE

PAARL: Bain's Kloof, Nov., *Schlechter* 9202 (S, PH, BM, K, PRE, GRA, BOL, BR, Z, G); Mountains at Paarl, April, *MacOwan* no. 777 in Herb. Norm. Austro. Afr. (SAM, GRA, BOL, Z, G, BM, K); Bushman's Castle, French Hoek, Oct., *Scholtz* s.n. sub SAM 59630 (SAM); Assegaaibooskloof, Aug., *van der Merwe* 1196 (STE); Groot Drakenstein, Jan., *Marloth* 9437 (STE); Du Toit's Kloof, Sept., *Thode* 8505 (STE); French Hoek, *Ludwig* s.n. in herb. Meisner (NY); Dal Josaphat, near Wellington, Jan., *Tyson* 935 (BOL, NH); Between Wellington and Bain's Kloof, Oct., *Levyns* 2389 (CT); French Hoek, Oct., *Phillips* 1268 (SAM); Du Toit's Kloof, 28/12/1827, *Drège* 14736 (P); On Paarlberg, 12/1/1828, *Drège* 1473 a a (P); Paarlberg,

31/8/1827, *Drège* 1473 a (P, SAM, S); French Hoek, Oct., *Barker* 4180 (NBG); Wemmershoek, Dec., *Compton* 10140 (NBG); Du Toit's Kloof, July, *Compton* 24100 (NBG); In clivis montosis French Hoek Pass, Nov., *Bohus* 5234 (BOL, Z); Berg River Hoek, Dec., *Esterhuysen* 12409, (BOL); Wemmershoek valley, Nov., *Esterhuysen* 17731 (BOL); Felixberg, lower slopes, April, *Esterhuysen* 7740 (BOL); Klein Drakenstein mts., between Wemmershoek and Paarl, Dec., *Rourke* 57 (BOL, NBG); Du Toit's Kloof, Aug., *Esterhuysen* 20302 (BOL, PRE); Bains Kloof, *Rehmann* 2327 (Z); Paarl Hills, anno 1799, *Dr. Roxburgh* 38 (G); Roberts vallei, French Hoek, Sept., *Rycroft* 2519 (NBG); Du Toits Kloof, Oct., *Acocks* 20641 (PRE, K); Groen Berg, Wellington, Sept., *Lewis Grant* 2417 (PRE); French Hoek, May, Oct., *Marloth* 4856, 8854 (PRE); French Hoek Pass, Oct., *van Breda* 696 (PRE, K); Upper west slopes of Hawequas mts., *Acocks & Hafstrom* 2110 (PRE); Mountains above French Hoek, Dec., *Galpin* 12422 (PRE, K); Roadside near French Hoek, *Letty* 51 (PRE); French Hoek mountains, towards Villiersdorp, Jan., *Marloth* 8169 (PRE); Paarl, Nov. 1846, *Alexander Prior* (K, SAM, PRE); Sandy plains, Paarl–Drakenstein, Oct., *Niven* 48 (K); Olyvenbosch farm near Wellington Nov., *Salter* 1783 (BM).

STELLENBOSCH: Jonkershoek, Swartbas Kloof, Sept,. *van Rensburg* 2121 (STE, PRE, K); Biesiesvlei, Jonkershoek, Nov., *Levyns* 7501 (CT); Jonkershoek, July, *Parker* 4583 (NBG, PRE, K); Between Hells Hoogte and Pniel, Sept., *Stanford* s.n. (BOL); Jonkershoek, Swartbas Kloof, *van der Merwe* 2041 (STE, PRE); Jakalsvlei, Jonkershoek, Nov., *H. C. Taylor* 6920 (PRE).

WITHOUT PRECISE LOCALITY: Prom. bon. spei, *J. Roxburgh* (G); *Masson* (BM); *Oldenburg* 501 (anno 1773) (BM); Without collector in herb. Lamarck; without collector, cat. no. 4099 in herb. Jussieu.

(19) **Leucospermum cordifolium** (Salisb. ex Knight). Fourcade in Trans. R. Soc. S. Afr. **21:** 97 (1932); Rourke in Jl S. Afr. Bot. **33:** 268 (1967).

Leucadendrum cordifolium Salisb. ex Knight in Knight, Cult. Prot.: 54 (1809). Type: Groot Hout Hoek, *Niven* 48, in herb. J. E. Smith, lectotype (LINN), isotype in herb. Martii (BR), fragm. in Salisb. mss. vol. **5:** 523 (BM).

Leucospermum nutans R. Br. in Trans. Linn. Soc. Lond. **10:** 98 (1810); Phillips and Stapf in Fl. Cap. **5:** 614 (1912). Type: "6 Leucospermum nutans, Africa australis, Mr. Masson" (BM).

Protea nutans (R. Br.) Poir. ex Steudel, Nomencl. Bot. ed 2, **2:** 400 (1841).

Leucadendron nutans (R. Br.) O. Kuntze, Rev. Pl. **2:** 579 (1891).

Leucospermum bolusii Phillips in Kew Bull. **1910:** 330 (1910), non Gandoger 1901; Phillips and Stapf in Fl. Cap. **5:** 615 (1912); Rourke in Jl S. Afr. Bot. **33:** 268 (1967). Type: In collibus prope Elim, 9/12/1896, *Bolus* 8586, holotype (K), isotype (BOL).

Leucospermum mixtum Phillips in Kew Bull. **1910:** 332 (1910); Phillips and Stapf in Fl. Cap. **5:** 615 (1912). Type: Cape, without locality or collector, (K).

Leucospermum integrifolium Gandoger and Schinz in Bull. Soc. bot. Fr. **60:** 53 (1913). Type: Klynriviersklоof, *Zeyher* 3678, holotype in herb. Gandoger (LY).

Leucospermum meisneri Gandoger in Bull. Soc. bot. Fr. **60:** 54 (1913). Type: Zwartberg, *Zeyher* 3678b, holotype in herb. Gandoger (LY).

A rounded spreading shrub to 2,0 m in diam., 1,5 m in height, with a single main stem and horizontally spreading stems often drooping onto the ground. *Flowering stems* suberect or horizontally spreading, 5,0—8,0 mm in diam., beset with a short indumentum of fine crisped hairs, becoming glabrescent. *Leaves* patent to suberect, ovate, cordate and entire to oblong obtuse and with up to 6 teeth at apex; 2,0—4,5 cm wide, 2,0—8,0 cm long; pubescent at first, soon glabrous; oblong obtuse at lower end of stem becoming ovate cordate and entire below inflorescence. *Inflorescences* depressed globose, 10,0—12,0 cm in diam., solitary, or in groups of 2 or 3; usually borne at right angles to flowering stem; pedunculate, peduncle to 1,5 cm long. *Involucral receptacle* narrowly conic acute, 3,0—3,5 cm long, 8,0 mm wide. *Involucral bracts* ovate acuminate, 4,0—5,0 mm wide, 8,0 mm long, closely adpressed imbricate, cartilaginous, thinly tomentose. *Bracteoles* obtrullate acuminate, concave, apex incurved; 7,0 mm wide, 8,0—10,0 mm long; cartilaginous, thickly lanate proximally. *Perianth* 3,0—3,5 cm long, yellow, orange or crimson. *Perianth tube* 8,0—10,0 mm long, cylindric glabrous. *Perianth claws* crimson to hyaline. The 3 adaxial claws united into a sigmoidly curved sheath, glabrous, but slightly hispid on margins of the 2 lateral adaxial claws, strong coiled subterminally in an adaxial direction. Abaxial claw sparsely puberulous. *Perianth limbs* ovate acute, 3,0 mm long, 2,0 mm wide, hispid. *Anthers* subsessile, ovate, filament 1,0 mm long, swelling into 2 fleshy protuberances at the base. *Style* 4,5—6,0 cm long, held horizontally but curved adaxially in subterminal region. *Pollen presenter* obliquely tubinate, apex truncate with an obliquely placed stigmatic groove. *Hypogynous scales* subulate, 2,0 mm long.

Diagnostic Characters: L. cordifolium is distinguished from related species having an obliquely turbinate pollen presenter, by its spreading growth habit, the horizontally spreading stems, the characteristic leaf spectrum ranging from oblong and toothed to ovate entire below the inflorescences and the sparsely pubescent perianth claws. The inflorescences are normally borne at right angles to the stem.

No type material of *L. cordifolium* has been traced among Salisbury's specimens at Kew but a duplicate specimen in Smith's herbarium has been chosen as the lectotype. This was almost certainly examined by Salisbury when he and Smith were still on good terms. Of particular importance is a pencil drawing by Salisbury of the perianth, style and fruit, labelled "Leucadendrum cordifolium" in his own handwriting, and now preserved in the British Museum (Natural History). (Salisbury mss. vol. 5 fl. 523.) This drawing together with a single complete flower attached to it and which may be assumed to have been removed from the type, helps to clarify the typification of the name *Leucadendrum cordifolium* Salisb. ex Knight.

Distribution and Ecology: The most northerly population of *L. cordifolium* is at Aries Kraal in the south eastern foothills of Kogelberg. From this point its range extends southwards through Bot River, Onrust, Shaw's Pass, Caledon and Stanford to Napier, Bredasdorp and Elim. The most southerly populations occur at the south end of the Soetanysberg.

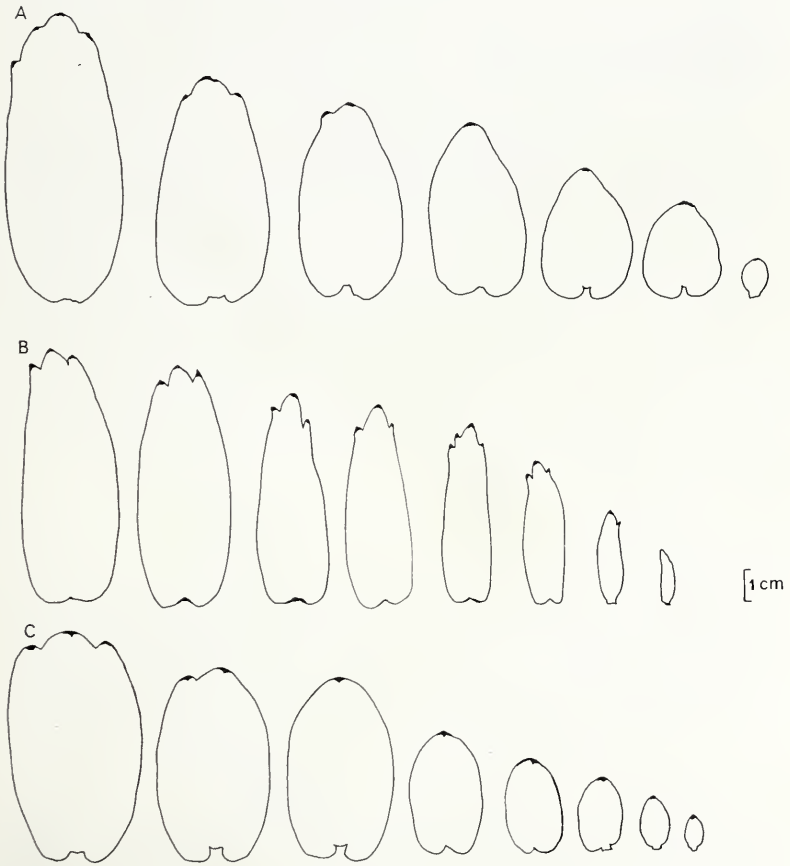


FIG. 28.
Leucospermum cordifolium (Salisb. ex Knight) Fourcade, showing the leaf spectra of three collections from the Bredasdorp district; (A) *Rourke* 1130; (B) *Rourke* 1177; (C) *Rourke* 596.

Whereas *L. patersonii* is confined to limestone outcrops or alkaline soil, *L. cordifolium* occurs only on acid soils derived from weathered Table Mountain Sandstone. Scattered individuals or fairly dense stands of up to several hundred plants are found in open hilly country between 100 and 1 500 ft. The associated vegetation consists of fairly dense Fynbos composed mainly of Restionaceae, Ericaceae and Proteaceae. A winter rainfall of 25–45″ p.a. is experienced. Flowering commences in August and continues until January. Although the style and perianth may vary from yellow to crimson, deep orange is the most frequently encountered colour.

Variation: A young, vigorously growing shoot of *L. cordifolium* has its leaves arranged along the stem in a characteristic spectrum. This leaf spectrum differs slightly from individual to individual but usually follows the pattern described here. The initial leaves on each new flowering shoot are oblong with several teeth at the apex and are normally obtuse at the base. Towards the apex of the shoot the leaves become progressively smaller, entire, lanceolate to broadly ovate in form, usually with cordate bases. Directly below the inflorescences the leaves may be almost scale-like (fig. 28).

Although this pattern is normally found in young, vigorous shoots, older shrubs tend to produce short shoots with oblong toothed leaves only. Taxonomically superfluous species have been founded on incomplete herbarium material, without having taken into account the great range of leaf form found on a single shrub at different phases of its development.

Specimens Examined:

CAPE

CALEDON: Houw Hoek Pass, Nov., *Salter* 4050 (K); Shaw's Mountain, Dec., *Salter* 5160 (K); Houw Hoek, *Mund* 16 (K); Houw Hoek, Feb., *Schlechter* 7332 (BM, PH, BOL, GRA, B, G, Z); Caledon, Sept., *Marloth* 8817 (STE, PRE); Kleyn River Kloof, Aug., *Zeyher* 3678 (SAM, Z); Top of Shaw's Pass, *Lewis* 3678 (SAM); Houw Hoek Oct., *Pappe* s.n. sub. SAM 19639 (SAM); In saxosis Houw Hoek, Oct., *Schlechter* 5441 (Z, PRE); Hermanus, Dec., *Compton* 14251 (NBG); Aries Kraal, Kogelberg Forest Reserve, Dec., *Rourke* 1000 (NBG); Shaw's Mountain, Jan., *Barker* 7204 (NBG); Swartberg, *Dr. Pappe* (S); Hartebeest River, Caledon, Jan., *Elbrecht* 19019 in herb. Tvl. Mus. (PRE); Ridge above Sandfontein, Caledon, Oct., *Galpin* 4459 (PRE); Shaw's mountain, Dec., *Acocks & Hafstrom* 2101 (PRE); Houw Hoek, Sept., *Werdermann & Oberdieck* 188 (PRE); Between Houw Hoek and Palmiet River, Nov., *Bolus* 5237 (BOL); Houw Hoek, Nov., *Thode* 8095 (STE).

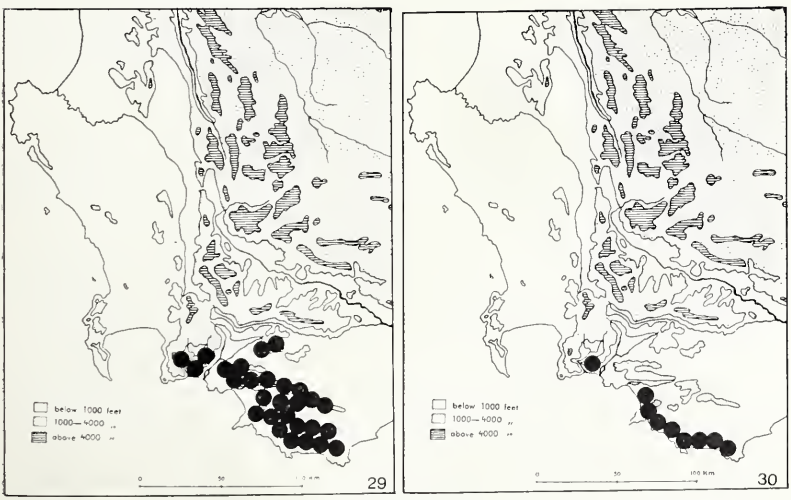
BREDASDORP: Near Gansbaai, Oct., *Baker* 1149 (BM); Nine miles west of Elim, Nov., *Salter* 4082 (BM, K); Koude River, Dec., *Schlechter* 9595 (Z, BM); In collibus prope Elim, Dec., *Bolus* 8586 (K, BOL); Bredasdorp mountain, Dec., *Galpin* 10469 (PRE, K) Mountain slopes at Napier, Oct., *van Breda* 1428 (STE); Baardscheerdersbosch, *Leighton* 2585 (BOL, NY); Springfield, hills among T.M.S. boulders, Jan., *Rycroft* 1824 (BOL, NBG); Between Caledon and Elim, Oct., *Bolus* 7858 (BOL); In collibus prope Elim Dec., *Krauss* s.n. (FI, M, Z); Brandfontein, Oct., *Esterhuysen* 19119 (BOL); Hagelkraal, between Gansbaai and Quoin Point, *Lewis* 2594 (SAM); Viljoenshof, Oct., *van Breda* 1419 (PRE); South slopes of Bredasdorp mts., Dec., *Acocks & Hafstrom* 2106 (PRE); South of Napier, Feb., *Compton* 22664 (NBG);

On the Pearly Beach Rd., Sept., *Richmond* 33 (NBG); Uitkomst River, Dec., *Compton* 10243 (NBG); Ratel River, Sept., *Compton* 14769 (NBG); Hagel Kraal, Jan., *Barker* 5281 (NBG); Mountains between Stanford and Elim, Sept., *Middlemost* 2205 (NBG); Elands Kloof mts., Koudeberg area, Sept., *Rourke* 596 (NBG); Springfontein, Dec., *Rourke* 1177 (NBG); Geelrug, north of Soetanysberg, Dec., *Rourke* 1177 (NBG).

WITHOUT PRECISE LOCALITY: Africa australis, *Masson* (BM); Cape, *Gueinzius* (NY, S); Cape, *Jules Verreaux* (G); Prom. b. spei, *Dr. Roxburgh* (G).

(20) **Leucospermum patersonii** Phillips in Bothalia **2**: 474 (1928). Syntypes: Hermanus mts., Oct. 1922, *Paterson* s.n. (11453 in herb. Marloth, PRE); Mountains of Hermanus, Oct. 1928, *Paterson* s.n. (PRE 7797, lectotype).

A large rounded shrub or small tree to 4,0 m in height; trunk stout, 10,0—20,0 cm in diam. *Flowering stems* erect, woody, 8,0—10,0 mm in diam., beset with a short dense indumentum of fine crisped hairs interspersed with straight, spreading trichomes. *Leaves* very broadly oblong to oblong, 5,0—9,0 cm long, 3,0—5,0 cm wide; cordate to auriculate at base; apex rounded with 3–8 teeth; leaves imbricate, glabrous. *Inflorescences* ovoid to globose, 8,0—9,0 cm in diam., usually solitary, occasionally in groups of 2 or 3; pedunculate, peduncle 1,0—2,0 cm long. *Involucral receptacle* narrowly conic acute, 4,0—5,0 cm



FIGS. 29 AND 30.
(29) Distribution of *Leucospermum cordifolium* (Salisb. ex Knight) Fourcade.—(30) Distribution of *Leucospermum patersonii* Phillips.

long, 0,7—1,0 cm wide. *Involucral bracts* ovate-acuminate, 1,0 cm long, 0,7 cm wide, tightly adpressed imbricate, cartilaginous, minutely puberulous to glabrous. *Bracteoles* obovate-cymbiform, apex acuminate; densely lanate proximally, 10,0 mm long, 8,0 mm wide. *Perianth* 2,5—3,0 cm long, very strongly adaxially curved in bud, orange to crimson. *Perianth tube* 5,0 mm long, cylindric, glabrous. *Perianth claws* becoming signoidly curved at anthesis, tapering and becoming strongly recurved subterminally; densely lanate. *Perianth limbs* ovate, 4,0 mm long, strongly recurved glabrous to hispid. *Style* 4,5—5,5 cm long, strongly adaxially arcuate subterminally. *Pollen presenter* obliquely turbinate, 3,0—4,0 mm long, 2,0 mm in diam., stigmatic groove oblique. *Hypogynous scales* 4,0 mm long, subulate, pale orange.

Diagnostic Characters: L. patersonii may be distinguished by its arborescent growth habit, the large, broadly oblong leaves with 3–8 teeth, the lanate perianth claws and the obliquely turbinate pollen presenter. The inflorescences are usually held erect.

L. patersonii was not unknown to the earliest botanical collectors for there are excellent specimens preserved in the herbaria of Burman (G) and Schreber (M), that were collected by Oldenland, the Dutch East India Company's master gardener at the Cape until 1697. These collections were filed under *L. conocarpodendron* and were apparently overlooked by 18th and 19th century monographers. About 230 years passed before it was collected again, this time by H. W. Paterson of Hermanus, after whom it was named.

Distribution and Ecology: The present range of *L. patersonii* extends from Cape Agulhas westwards along the coastal belt to Stanford, with an outlying population at Heuningklip Kloof, Kleinmond. This species previously occurred at Hermanus but has since been exterminated there.

L. patersonii is a coastal species, restricted to the ridges of limestone hills lying adjacent to the sea, between Cape Agulhas and Stanford, at elevations of 150–800 ft. Limestone, or a limestone derived soil appears to be one of the most important ecological requirements of this species. Apart from a small aberrant population at Heuningklip Kloof, Kleinmond, all other populations are confined to limestone deposits of the Alexandria formation. In most cases the plants root system is intimately associated with the soft subsurface layers of limestone.

This species is one of the largest in the genus becoming an erect upright shrub of almost tree-like form, reaching 15 ft. in height. *L. patersonii* usually occurs in fairly dense stands in association with other calciphilous Proteaceae such as *Leucadendron meridianum*, *Protea obtusifolia* and *Mimetes saxatilis*.

It appears to have a certain degree of fire resistance as mature plants are capable of regenerating from the stem apices if the intensity of the fire is not too great. Flowering commences in August and continues until December.

Specimens Examined:

CAPE:

CALEDON: Hermanus mts., Oct. 1922, *Paterson* s.n. sub 11453 in herb. Marloth (PRE); Hermanus mts., *Marloth* 8818 (STE); Mountains of Hermanus, Oct. 1928, *Paterson* s.n. sub PRE 7797 (PRE); Mossel River, Hermanus, Sept., *L. Guthrie* 171 (BOL); Mountains above Kleinmond in Heuning Klip Kloof, Nov., *Cloete* s.n. sub SAM 60941 (SAM); Heuning Klip Kloof, Kleinmond, Jan., *Cloete* s.n. (NBG).

BREDASDORP: Vintjieskraal, June, *van Breda & Admiraal* 1857 (PRE); Near Gansbaai, July, Linley s.n. sub SAM 60386 (SAM); Uilkraal, May, *Jordaan* 918 (STE); Hill one quarter mile east of Agulhas, Dec., *Pillans* 8146 (BOL); Hagelkraal River, Dec., *Leighton* 2557 (BOL); Baardscheerdersbosch, Jan., *Barker* 5291 (NBG); Hagelkraal, Dec., *Compton* 19052 (NBG); Limestone hills near Danger Point, Jan., *Lewis* 2082 (SAM); Limestone hills between Waterford and Hagelkraal, Aug., *Rourke* 521 (NBG); Heidehof, Uilenkraal River, Aug., *Rourke* 531 (NBG); Hills above Pearly Beach, Aug., *Rourke* 511 (NBG); Hills above De Kelders, Aug., *Rourke* 505 (NBG); Soetanysberg, on the farm Hangnes, Oct., *Rourke* 1129 (NBG).

WITHOUT PRECISE LOCALITY: *Oldenland* in herb. Burman (G), and in herb. Schreber (M).

(21) **Leucospermum cordatum** Phillips in Flower. Pl. S. Afr. **3** t. 95 (April 1923); in Kew Bull. **1923:** 185 (May 1923). Type: Hottentots-Holland mts., near Kogelbay, Oct. & Nov. 1922, *Stokoe* s.n., holotype (PRE 2607), isotypes (K, BM, G, Z, BR).

A low trailing shrub 15,0—25,0 cm in height, forming loose diffuse mats 1,0—2,0 m in diam., with a single main stem at base, trunk to 3,0 cm in diam., bark smooth, grey. *Flowering stems* slender, sprawling horizontally or trailing, 3,0—4,0 mm in diam., sparsely puberulous with soft, erect, spreading trichomes. *Leaves* ovate, cordate to auriculate at base, 3,0—5,5 cm long, 1,0—2,5 cm broad, apex entire; leaves patent, widely spaced, puberulous at first with a dense, short indumentum of fine crisped hairs, soon glabrous. *Inflorescences* depressed globose, 3,0—4,0 cm in diam.; pedunculate, peduncle 2,0—5,0 cm long, 2,0—3,0 mm in diam. *Involucral receptacle* conic depressed, 7,0 mm long, 7,0 mm wide. *Involucral bracts* ovate acute to abruptly acute, 5,0 mm broad, 7,0—10,0 mm long, imbricate, cartilaginous, softly tomentose, margins densely ciliate. *Bracteoles* obovate 8,0—10,0 mm long, 5,0—6,0 mm wide, apex abruptly acuminate; cartilaginous, lanate proximally, margins thickly ciliate. *Perianth* 1,5—1,8 cm long, pale cream to hyaline, strongly adaxially curved in bud. *Perianth tube* cylindric, 5,0 mm long, glabrous. *Perianth claws* hyaline, beset with long, straight spreading trichomes (2,0—3,0 mm), the median adaxial claw glabrous to glabrescent; claws narrowing distally to half their proximal width.

Perianth limbs elliptic, 4,0 mm long, 1,5 mm wide, very strongly recurved, villous. *Style* strongly adaxially arcuate, tapering subterminally, 2,0—2,5 mm long; white or tinged pale pink. *Pollen presenter* narrowly conic acute geniculate, 2,5 mm long, pink fading to white. *Hypogynous scales* linear obtuse, 3,0 mm long.

Diagnostic Characters: L. *cordatum* is distinguished by its prostrate growth habit, the entire, ovate acute leaves with prominently cordate to auriculate bases, the short, strongly incurved style (2,0—2,5 cm long) and the conic acute pollen presenter geniculate at its junction with the style.

Distribution and Ecology: The only known population of *L. cordatum* occurs midway between Kogel Bay and Rooi Els on the lower western slopes of Rooi Els Berg near the disused Manganese mine. The plants observed grow on steep west facing slopes between 50 and 250 ft. above sea level growing in association with low, tufted *Restionaceae*. The substratum consists of coarse Table Mountain Sandstone gravel with an admixture of clay and is situated just above the lower T.M.S. shaleband. A fairly high winter rainfall of 30–40″ p.a. is ex-

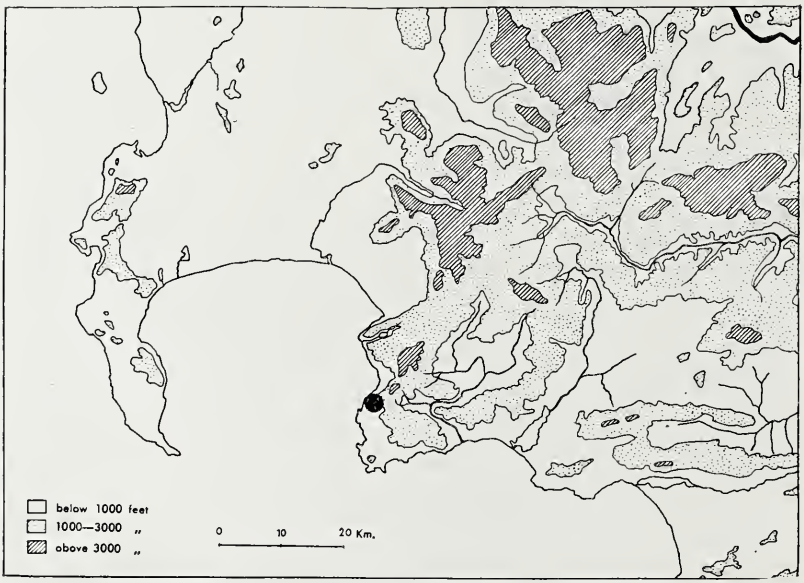


FIG. 31.
Distribution of *Leucospermum cordatum* Phillips.

perienced here. The mature plants have a low diffuse growth habit with stems trailing over the ground and eventually develop into loose mats up to 2,0 m in diam., but not exceeding 25,0 cm in height. The pale cream inflorescences with pink flushed styles are produced between July and December but the peak of the flowering period is from September to November.

Specimens Examined:

CAPE

CALEDON: Hottentots-Holland mts., near Kogel bay, Oct. & Nov., *Stokoe* s.n. (PRE 2607, K, BM, G, Z, BR); Hottentots-Holland mts., near Kogelbay, Nov., *Stokoe* 540 (STE, PRE); Hottentots-Holland mts., between Steenbras and Rooi Els, Oct., *Stokoe* s.n. (BOL 17376); Slopes between Gordon's bay and Rooi Els, Dec., *Stokoe* s.n. (SAM 25292); Kogel bay area, July, *Macpherson* s.n. (NBG 88741); Below the old mine, Kogel bay, Sept., *Boucher* 563 (STE, NBG); Lower north west slopes of Rooi Els Berg, 100 yds from disused Manganese mine, Nov., *Rourke* 1227 (NBG).

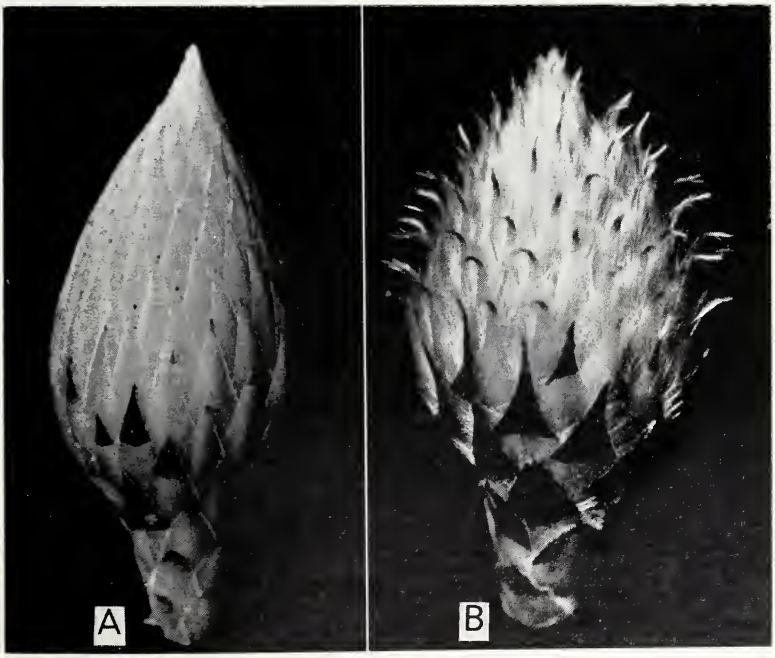


FIG. 32.

Immature inflorescences of (A) *Leucospermum catherinae* Compton and (B) *Leucospermum grandiflorum* (Salisb.) R. Br. The immature inflorescence of *L. formosum* (Andr.) Sweet is the same as (A) and that of *L. gueinzii* Meisn. is the same as (B). Both X2.

Sect. 5. CARDINISTYLUS Rourke, sect. nov.

Frutices grandes, 2,0—3,0 m alti. Receptaculum involucrale perangustum conicum acutum. Styli 5,5—8,0 cm longi, torquent per 90° per anthesin moventes. Stigma anguste cylindraceum, acutum.
Large shrubs 2,0—3,0 m in height. Involucral receptacle narrowly conic acute. Style 5,5—8,0 cm long, hinged, moving through 90° during flowering. Pollen presenter narrowly cylindric, acute.

Type: *L. formosum* (Andr.) Sweet.

Apart from the very distinct *L. praemorsum* and *L. reflexum*, the remaining taxa of this section can be referred to two groups based on the morphology and pubescence of the immature inflorescences. Those species in which the bracts of the immature inflorescence are squarrose with acuminate recurved involucral bracts, prominently crinite at the apex, from a distinct group comprising *L. grandiflorum* and *L. gueinzii*. A second group in which the bracts of the inflorescence buds are tightly adpressed imbricate and glabrous, contains a less easily distinguishable pair of vicarious taxa. (Fig. 32.)

Within this latter group, populations occurring on the Langeberg are characterised by sessile, permanently pubescent leaves beset with a fine, dense, greyish indumentum of short crisped hairs. Material from the Cedarberg, Piketberg and Cold Bokkeveld is characterised by having prominently petiolate leaves which are quite glabrous. There is also an obvious trend towards shorter leaves in the Langeberg population and longer leaves in the Cedarberg, Piketberg and Cold Bokkeveld population, but no absolute distinction can be made on leaf length (fig. 33).

However, as the populations differ in two characters, they should be accorded specific rank. In the *Flora Capensis* material from the Langeberg population was incorrectly cited under *L. grandiflorum* while the name *L. formosum* which should have been applied to it was quoted as a synonym of *L. ellipticum*. Despite this confusion it is now clear that the Langeberg material should be referred to *L. formosum* and the material from the Cedarberg, Piketberg and Cold Bokkeveld, as *L. catherinae*.

(22) **Leucospermum formosum** (Andr.) Sweet, Hort. Suburb. Lond.: 21 (1818); — non *L. formosum* (Salisb. ex Knight) Loud., Encycl. Pl.: 82 (1829).
Protea formosa Andr., Bot. Repos. t. 17 (1798).
Leucadendrum formosum (Andr.) Salisb. ex Knight in Knight, Cult. Prot.: 54 (1809).
Leucadendron formosum (Andr.) O. Kuntze, Rev. Gen. Pl. **2:** 578 (1891).

A large erect shrub to 3,0 m in height, with a single main stem at base. *Flowering stems* erect, to 8,0 mm in diam., covered with a short, dense indu-

mentum of fine crisped hairs interspersed with long erect trichomes 5,0—7,0 mm long. *Leaves* lanceolate elliptic, 6,5—10,0 cm long, 1,4—2,0 cm wide, sessile to subsessile, loosely ascending imbricate, softly velutinous in texture, covered with a dense grey indumentum of fine crisped hairs; apex sharply trifid, rarely entire. *Inflorescences* turbinate to depressed discoid, 15,0 cm in diam.; pedunculate, peduncle 1,0—2,0 cm long; usually solitary, rarely in groups of 2 or 3. On opening, the styles elongate rapidly and curve abaxially as the inflorescence develops. *Involucral receptacle* narrowly conic acute, 5,0—5,5 cm long, 1,0—1,5 cm broad. *Involucral bracts* ovate acute, 1,0—1,5 cm long, 0,7 cm wide, tightly adpressed imbricate, thin and papyraceous in texture, outer surface puberulous, soon glabrescent; margins ciliate. *Bracteoles* lanceolate acute to acuminate; cymbiform, margins involute; 2,0 cm long, 0,8—1,0 cm wide, thickly lanate proximally, margins ciliate, apex crinite. *Perianth* 5,0 cm long, golden yellow. *Perianth tube* 1,0 cm long, slightly laterally compressed, glabrous proximally, puberulous distally. *Perianth claws* filiform, but broadening proximally; becoming tightly coiled on opening: beset with long spreading trichomes on outer surface. *Perianth limbs* very narrowly lanceolate acuminate, 7,0 mm long, 1,0 mm wide, outer surface beset with long, erect trichomes; apex minutely crinite, *Style* 7,0—8,0 cm long, elongating rapidly, tapering and twisting clockwise subterminally, pale yellow becoming amber flushed with bronze. *Pollen presenter* narrowly cylindric acute, 0,7 cm long, slightly geniculate, curved clockwise almost at right angles to style; white, aging to pink; stigmatic groove terminal. *Hypogynous scales* subulate 3,0 mm long.

Diagnostic Characters: L. formosum is distinguished from related taxa by its sessile to subsessile lanceolate-elliptic leaves, 6,5—10,0 cm long, covered with a soft, permanent, greyish indumentum of fine crisped hairs.

The earliest validly published description of this species is that of Andrews in 1798 under the name *Protea formosa* Andr. The description was accompanied by an excellent colour plate, clearly depicting the diagnostic characters of the species. Later authors failed to identify any further collections with *P. formosa* Andr., except Salisbury who had seen specimens in the Chapel Allerton collection where it had flowered and even "ripened seeds" [Knight,: 54 (1809)]. Drawings of a leaf, style and perianth as well as descriptive notes by Salisbury are preserved in the collection of Salisbury's manuscripts, vol. 5 fl. 520 at the British Museum (BM).

Considerable confusion was caused by Brown who tentatively cited *P. formosa* Andr. as a synonym of *Leucospermum medium* R. Br., while at the same time describing an additional species, *P. formosa* R. Br. Apart from being a later homonym of *P. formosa* Andr., *P. formosa* R. Br. is synonymous with *P. com-*

pacta R. Br. Subsequent monographers all followed Brown despite the fact that *P. formosa* Andr. bears not the slightest resemblance to *L. medium* R. Br.

Andrews' plate was painted from a plant which had flowered in the nursery of Messrs. Lee & Kennedy in August 1796. He notes that it had been introduced by Masson without giving any further details regarding its locality. Although the precise locality at which Masson collected the seeds will never be known, it is very likely to have been on the south slopes of the Langeberg near the Ruitersbos Forest Reserve. On the 19th of November, 1773, Masson and Thunberg crossed the Langeberg by way of Attaquas Kloof (near the present day Robinson Pass at Ruitersbos). At precisely this time ripe seeds of *L. formosum* would have been available for collection. Masson could therefore have easily gathered seeds on this occasion.

Specimens collected at Ruitersbos match Andrews' plate in every detail, particularly the leaves which he described as "lance shaped, downy". Young plants flowering for the first time tend to produce entire leaves as illustrated by Andrews, but tridentate leaves are produced by mature plants.

Distribution and Ecology: Only a few scattered populations of *L. formosum* are known. These occur on the southern slopes of the Langeberg Range between Dassieshoek Peak, Robertson, and Duivels Kop near George. The population at Garcia's Pass where Galpin collected specimens in 1897 now appears to have been exterminated while at Ruitersbos where the largest and most vigorous stands occur, the species is being threatened by afforestation.

L. formosum grows only in cool, south facing situations between 600 and 3 000 ft., in moist peaty soils. The mean annual rainfall of 25–40″ p.a. is evenly distributed throughout the year. The associated vegetation consists of tall dense sclerophyll, mainly Ericaceae, Restionaceae and Proteaceae. Flowering takes place from September to October.

Specimens Examined:

CAPE

ROBERTSON: Dassieshoek Peak, south slopes, Sept., *Esterhuysen* 29135 (NBG).

RIVERSDALE: Mountains at Garcia's Pass, Sept., *Galpin* 4458 (PRE, K).

GEORGE: At Pacaltsdorp, Oct., *Zeyher* s.n. sub SAM 19625 (SAM); Ruitersbos Forest Reserve, *Vogts* 311 (BOL); Pacaltsdorp, 6th Oct., 1847, *Alexander Prior* s.n. (K, PRE); Ruitersbos Forest Reserve, June (in bud), *Rourke* 467 (NBG); Duivels Kop, in loamy soil, *Bowie* s.n. (BM); South slopes of Outeniqua mts. at Ruitersbos Forest Reserve, Oct., *Rourke* 620 (NBG).

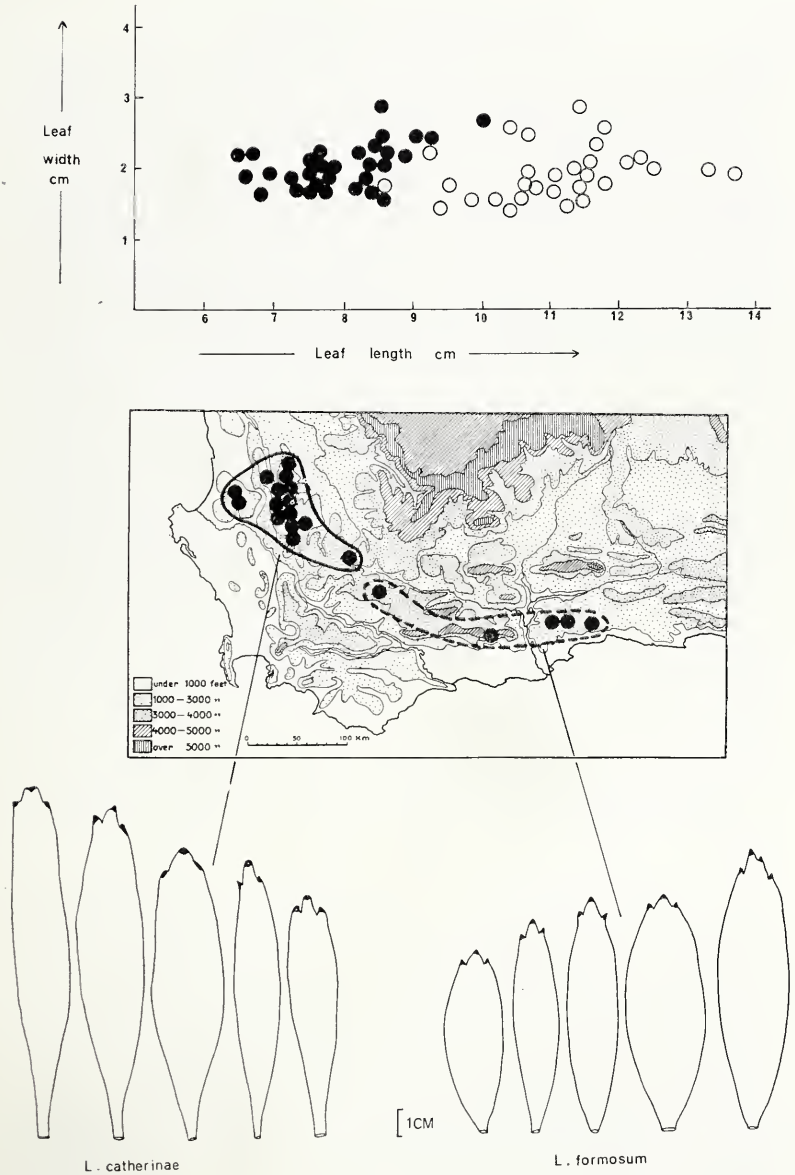


FIG. 33.

Distribution of *Leucospermum formosum* (Andr.) Sweet and *L. catherinae* Compton, showing variation in the form and dimensions of the leaves. In the scatter diagram the solid circles represent *L. formosum* and the open circle *L. catherinae*.

(23) **Leucospermum catherinae** Compton in J. Bot., Lond. **71**: 69 (1933). Type: Ceres Wild Flower Show, 5th Oct. 1931, *Compton* 3958 (sub BOL 20079), lectotype (BOL), isotype (K.)

An erect shrub to 3,0 m in height, becoming spreading with age; with a single main stem at base. *Flowering stems* erect, 5,0—8,0 mm in diam., puberulous. *Leaves* oblanceolate-elliptic, 9,0—13,5 cm long, 1,0—2,5 cm wide, attenuate to petiolate at base, apex deeply and obtusely 3 or 4 toothed; glabrous; loosely ascending imbricate. *Inflorescenses* depressed globose on opening, flattening to discoid later, 15,0 cm in diam.; pedunculate, peduncle 1,0 cm long; usually solitary. *Involucral receptacle* narrowly conic acute, 3,5 cm long, 1,0 cm wide. *Involucral bracts* ovate acute 1,0—1,5 cm long, 0,5—0,8 cm wide, closely adpressed imbricate, membranaceous, margins ciliate. *Bracteoles* lanceolate acuminate, 1,8 cm long, 0,5 cm wide, densely lanate proximally, membranaceous and puberulous distally on the outer surface. *Perianth* 4,0—5,0 cm long, pale orange when fresh. *Perianth tube* 6,0—7,0 mm long, ventricose adaxially, keeled and puberulous distally, glabrous proximally. *Perianth claws* filiform, becoming tightly coiled on opening; outer surface pilose; the three adaxial claws thickened and fleshy at base. *Perianth limbs* very narrowly lanceolate acute, 6,0 mm long, 1,5 mm wide, outer surface thickly sericeous. *Style* 7,0—8,0 cm long, tapering subterminally; elongating rapidly on opening and arching abaxially, the upper third being bent clockwise at rightangles to the proximal two thirds; orange at anthesis, becoming coppery bronze with age. *Pollen presenter* 6,0 mm long, narrowly cylindric acute, stigmatic groove terminal; magenta when fresh. *Hypogynous scales* 3,0 mm long, subulate, hyaline.

Diagnostic Characters: L. catherinae may be distinguished by its glabrous, oblanceolate elliptic, distinctly petiolate leaves, 9,0—13,0 cm long, 1,0—2,5 cm wide, with obtusely 3 or 4 dentate apices.

The earliest recorded collection of this species was made by Masson but without a precise locality being given. When Compton described *L. catherinae* in 1933, its exact locality was still uncertain for the type material was obtained from the Ceres wild flower show. The only localised collection available was a specimen collected in 1897 by Bodkin on the Krakadouw Pass in the Cedarberg but this was apparently not known to Compton at the time. The specific epithet "catherinae" was chosen partly because of the wheel-like appearance of the inflorescence seen in apical view and partly to commemorate the name of Mrs. Catherine van der Byl who provided Prof. Compton with information regarding the location of wild populations of this species (R. H. Compton, private communication).

Distribution and Ecology: The range of *L. catherinae* extends from Middelberg in the Cedarberg, southwards, to the Cold Bokkeveld and Ceres mountains with outlying populations on the Piketberg and at Bokkerivier.

L. catherinae grows almost exclusively in moist situations and is generally found along the margins of perennial streams, at elevations varying from 2 000 to 4 000 ft. Level sandy flats along stream banks or seepage areas where the substratum is composed of coarse grit derived from weathered Table Mountain Sandstone, are the most favoured habitats. Very occasionally small groups are found on drier rocky slopes. Large stands are seldom encountered as most populations are small, consisting only of a few individuals, while solitary widely dispersed plants are not unusual. Flowering takes place from September to December.

Specimens Examined:

CAPE

CLANWILLIAM: Cedarberg mountains at Krakadouw Pass, Oct. 1897, *A. Bodkin* s.n. (BOL); Driehoek, Cedarberg, *Vogts* 330 (BOL); Warmbaths, Oliphants River valley, Oct., *Engels* s.n. sub. BOL 13330 (BOL); Eland's Kloof, Sept., *Levyns* 5814 (CT); Elands Kloof, Sept., *Compton* 16145, 20964, 6444 (NBG); Oct., *Compton* 9659 (NBG); Middelberg, upper Jan Dissels river valley, Oct., *Gill* 46 (NBG); Duivels Kloof, Jan., Sept., *Stokoe* s.n. sub SAM 56568 and SAM 65164 (SAM); Cedarberg Pass, Dec., *Kruger* 950 (NBG); Driehoek valley, Cedarberg, *Pocock* 417 (PRE); Elands Kloof Pass, Sept., *Acocks & Hafstrom* 390 (PRE, S); Between Witte Els Kloof and Lambertshoek Berg, Oct., *Pillans* 9149 (BOL).

PIKETBERG: Top of Piketberg, Oct., *Middelmann* 3 (NBG); Piketberg mountain, Oct., *Krige* s.n. sub STE 10547 (STE); Piketberg mountain, Sept., *Martin* 252 (NBG); Piketberg mountain, Nov., *Compton* 23001 (NBG); Hills N.W. of Moutons Vlei, Nov., *Pillans* 7431 (BOL).

CERES: Road between Rosendalfontein and Visgat, Nov., *Pillans* 9750 (BOL); Ceres Wild Flower Show, Oct., *Compton* 4112 & 3958 sub BOL 20079 (BOL); Waboomsriver, Dec., *Lewis* 1207 (SAM); Visgat between Schurfteberg and Great Winterhoek, *Stokoe* s.n. sub SAM 63178 (SAM); Bokkeriver Farms, Nov., *Middlemost* 2271 (NBG); Waboomsriver flats, Aug. (in bud), *Rourke* 558 (NBG); Onderboskloof, Cold Bokkeveld, Oct., *Rourke* 679 (NBG).

WITHOUT PRECISE LOCALITY: Prom. bonae Spei, *F. Masson* s.n. (G).

(24) **Leucospermum grandiflorum** (Salisb.) R. Br. in Trans. Linn. Soc. Lond. **10:** 100 (1810); Phillips & Stapf in Fl. Cap. **5:** 623 (1912).
Leucadendrum grandiflorum Salisb., Parad. Lond. t. 116 (1808); in Knight, Cult. Prot. 54 (1809). Iconotype: Parad. Lond. t. 116.
Protea villosiuscula Banks ex R. Br. in Trans. Linn. Soc. Lond. **10:** 100 (1810),— nom. nud.
Protea villosa Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 566 (1816),— nom. supfl.
Protea erosa Licht. ex Spreng., Syst. Veg. **1:** 464 (1825),—nom. nud.

An erect shrub to 2,5 m in height with a single stout main stem. *Flowering stems* erect or slightly sprawling, beset with a sparse indumentum of short

crisped hairs, interspersed with straight, patent, silky trichomes 5,0 mm long. *Leaves* broadly elliptic to elliptic-oblong, 5,0—8,0 cm long, 2,0—3,0 cm wide, apex obtuse usually tridentate, very rarely entire; pubescent, with a fine greyish indumentum of short crisped hairs. *Inflorescences* ovoid on opening becoming depressed-ovoid, 10,0—12,0 cm in diam., subsessile to pedunculate, peduncle to 1,5 cm long. *Involucral receptacle* narrowly conic acute, 4,0 cm long, 1,0 cm wide. *Involucral bracts* ovate acute, 1,0—1,5 cm long, 0,5—0,8 cm wide, cartilaginous proximally becoming brown and membranaceous distally; margins densely ciliate, apices crinite. *Bracteoles* 2,0 cm long, 0,5 cm wide, lanceolate acuminate, apices slightly recurved; very thickly lanate proximally, sericeous distally. *Perianth* 4,5—5,0 cm long, pale greenish yellow. *Perianth tube* 7,0 mm long, glabrous; narrowed proximally, adaxially ventricose distally. *Perianth claws* becoming sigmoidly curved at anthesis; beset with a few slender, spreading trichomes. *Perianth limbs* 8,0 mm long, narrowly lanceolate linear, acute; sericeous. *Style* 7,0—7,5 cm long, tapering subterminally, slightly obliquely deflected in a clockwise direction; yellow at anthesis becoming crimson with age. *Pollen presenter* cylindric acute, 6,0—8,0 mm long, pink becoming carmine; stigmatic groove terminal. *Hypogynous scales* subulate, 3,0 mm long.

Diagnostic Characters: The broadly elliptic to elliptic oblong leaves, 5,0—8,0 cm long, usually tridentate at the apex, permanently pubescent with a fine grey crisped indumentum and the perianth 4,5—5,0 cm long, distinguish *L. grandiflorum* from related taxa. The style and perianth are bright yellow at anthesis.

Collections of *L. grandiflorum* were made at Paarl as early as 1799, by Roxburgh and Niven. Moreover, it was raised from seed collected by Niven and successfully cultivated in Hibbert's conservatory where it "flowered, and ripened seeds, for several years" according to Salisbury. Salisbury's description in the Paradisus Londinensis (t. 116, 1808), was accompanied by an excellent colour plate which must serve as the lectotype of *L. grandiflorum* since no herbarium material appears to have been preserved.

Distribution and Ecology: Apart from a few isolated localities in the Berg River valley where it is now almost extinct, *L. grandiflorum* still occurs on Paarl mountain, on the hills around Durbanville and on the Paardeberg at Malmesbury.

Throughout its range, *L. grandiflorum* grows mainly on clayey soils derived from weathered Cape Granite but is occasionally found on Tertiary sand underlain with Malmesbury gravel. It occurs in hot, dry, exposed habitats, often in a north facing position, in association with low scrub composed mainly of *Elytropappus rhinocerotis*, *Eriocephalus africanus* and various *Rhus* spp. A rather low winter rainfall of 15—25″ p.a. is experienced in these areas. Flowering takes place from July to November.

Specimens Examined:

CAPE

MALMESBURY: Upper N.E. slopes of Paardeberg, Aug., *Pillans* 7643 (BOL); Lammershoek, Paardeberg, Sept., *Garside* 5042 (BOL, NBG); Near reservoir, Paardeberg, Sept., *Martin* 1186 (NBG).

BELLVILLE: Between Paarl Rd. and railway at Muldersvlei, June, *Acock* 4652 (S); N.W. of Hercules Pillar, July, *Acock* 4804 (S); Phisantekraal, July, *Barker* 10247 (NBG); Between Volmoed and Hercules Pillar, Oct., *Rourke* 941A (NBG); Phisantekraal, Oct., *Rourke* 938 (NBG).

PAARL: Near Paarl, Nov., *Schlechter* 9211 (PH, PRE, K, BM, G, NH, GRA, BOL, BR, Z, S); Berg River valley, Jan., *Marloth* 10058 (PRE, STE); French Hoek, *Ludwig* s.n. (NY); Near Wellington, Sept. *Zeyher* s.n. (GRA, BOL); Paarl mountain, Jan., *Bolus* 5570 (BOL, BM); Foot of Paarlberg, Sept., *Hutchinson* 461 (BOL, BM, PRE, K); Between Durbanville and Paarl, July, *L. Guthrie* 172 (BOL); Mountains round French Hoek, Oct., *MacOwan* 2905 (SAM, K); Paarlberg, 16/10/1828, *Drège* s.n. (P); Paarlberg, 17/8/1827, *Drège* s.n. (P); Pearl hills, Oct., *Dr. Roxburgh* 37 (G); Paarl mtn., Oct., *Henderson* 1194 (NBG); Oct., Compton 22942 (NBG); Dal Josaphat, Aug., *Lewis Grant* 2335 (PRE); Paarl, Aug., *Marloth* 5218 (PRE); In montibus Paarl, Oct., *Pappe* s.n. (PRE); Wellington, *Pappe* s.n. (PRE); Olyvenbosch Farm, Wellington, Nov., *Salter* 1782 (BM, K).



FIGS. 34 AND 35.
(34) Distribution of *Leucospermum grandiflorum* (Salisb.) R. Br.—(35) Distribution of *Leucospermum gueinzii* Meisn.

(25) **Leucospermum gueinzii** Meisn. in DC., Prodr. **14:** 254 (1856). Type: In Africa Capensi, *Gueinzius*, lectotype in herb. Meisner (NY), isotype (S).

Stout erect shrub 2,0—3,0 m in height, with a single main stem; branches erect, ascending. *Flowering stems* 6,0—9,0 mm in diam., covered with a dense indumentum of fine crisped hairs interspersed with long erect trichomes. *Leaves* lanceolate acute, 7,5—10,0 cm long, 2,0—3,0 cm wide; usually entire, rarely with 2, 3 or 4 teeth at apex; glabrous but occasionally minutely puberulous at first; sessile, ascending imbricate; bright green when fresh. *Inflorescences* ovoid on opening, depressed ovoid when mature, 10,0—14,0 cm in diam., usually solitary, occasionally in groups of up to 3; pedunculate, peduncle to 1,0 cm long. *Involucral receptacle* narrowly conic acute, 4,0—4,5 cm long, 1,0—1,2 cm wide. *Involucral bracts* broadly ovate acute, the innermost whorl becoming acuminate; 1,5—2,4 cm long, 0,5—0,8 cm wide; cartilaginous proximally becoming brown and membranaceous distally, margins densely ciliate, apices usually crinite. *Bracteoles* lanceolate acuminate 2,5—3,0 cm long, 0,5—0,9 cm wide, cartilaginous, thickly lanate proximally, apex minutely crinite, margins ciliate. *Perianth* 5,5—6,0 cm long, greenish yellow proximally, amber distally. *Perianth tube* 7,0 mm long, glabrous, narrowed proximally, adaxially ventricose distally. *Perianth claws* sparsely sericeous with a few straight erect trichomes; becoming sigmoidly recurved subterminally. *Perianth limbs* very narrowly lanceolate acute, 1,0 cm long, 0,2 cm wide, beset with a shaggy indumentum interspersed with long, slender trichomes; apex crinite. *Style* 7,0—7,5 cm long, tapering and becoming sharply curved abaxially in the subterminal region; deep orange. *Pollen presenter* 0,8—1,0 cm long, cylindric acute, pointing abaxially; stigmatic groove terminal. *Hypogynous scales* subulate, 3,0 mm long, ivory.

Diagnostic Characters: L. gueinzii is distinguished from *L. grandiflorum* by its glabrous, lanceolate acute to elliptic leaves, 7,5—10,0 cm long, usually entire, very rarely with up to 3 teeth at the apex and the perianth 5,5—6,0 cm long. The style and perianth are deep orange at anthesis.

A specimen in Meisner's herbarium (NY) annotated in his own hand is proposed as the lectotype of *L. gueinzii*. The species was named after Wilhelm Gueinzius who collected at the Cape between 1839 and 1841.

Distribution and Ecology: This species is confined to the Hottentots Holland mountains where it occurs at Jonkershoek, Bushmans Castle, on the Helderberg and near Sir Lowry's Pass. Collections of this species were made at Houw Hoek by Zeyher but it now appears to be extinct there.

L. gueinzii requires a very much moister environment than *L. grandiflorum* as its entire distribution range falls within a region receiving 30—45″ p.a. Sheltered kloofs near stream banks at elevations varying from 1 000—3 000 ft. in dense sclerophyll are particularly favoured habitats. It is restricted to heavy clayey soils derived from weathered Cape Granite. Flowering takes place from August to December. On opening, the perianth and style are deep orange but become bright crimson with age.

Specimens Examined:

CAPE

STELLENBOSCH: Helderberg, Oct., *Herre* 2191 (STE); Guardian Peak, Oct., *Esterhuysen* 12005 (BOL); Helderberg, Nov., *Parker* 3876 (BOL, NBG, K); Abdol's Kloof, Jonkershoek, Oct., *Levyns* 7376 (CT); Helderberg, Oct., *Parker* 4527 (SAM, K, PH); French Hoek mts., Bushmans Castle, Oct., *Scholtz* s.n. sub SAM 60931 (SAM); Langrivier, Jonkershoek, Aug., *Kerfoot* 5478 & 5507 (NBG); Langrivier, Jonkershoek, Aug., *Rourke* 1092 (NBG); Abdol's Kloof, Jonkershoek, Aug., *Rourke* 831 (NBG); Swartboskloof, Sept., *van der Merwe* 26/12 (PRE).

SOMERSET WEST: Sir Lowry's Pass, Sept., *Levyns* 3920 (CT); Western foot of Hottentots Holland mts. below Kaatjies Kloof, Aug., *Esterhuysen* 17384 (BOL, PRE).

CALEDON: Houwhoek, Sept., *Zeyher* s.n. sub SAM 19630 (SAM, G).

WITHOUT PRECISE LOCALITY: C.B.S., *Masson* (G); C.B.S., *Brehm* (M); In Africa Capensi, *Gueinzius* (NY, S).

(26) **Leucospermum praemorsum** (Meisn.) Phillips in Fl. Cap. **5:** 623 (1912).
Leucospermum attenuatum R. Br. var. *praemorsum* Meisn. in DC., Prodr. **14:** 257 (1856). Type: Sandy flats at Biedouw, 13/12/1830, *Drège* 2416 (lectotype B, isotypes P, K).
Leucospermum praemorsum Buek, in Drège Zwei Pfl. Docum.: 73, 199 (1844). Nom. nud.

Large shrubs or small trees to 5,0 m in height, 7,0 m in diam., with a single stout trunk to 30,0 cm in diam., branching at 30,0 cm from ground level. Bark smooth, grey. *Flowering stems* rigid, erect, 5,0—7,0 mm in diam., villous-cinereous at first, soon glabrous. *Leaves* oblong-oblanceolate, 7,0—8,0 cm long, 1,5—2,0 cm broad, glabrous; tapering to a distinct petiole up to 2,0 cm long, villous-arachnoid at base; apex truncate, praemorse, with 3—5 teeth, slightly undulate. *Inflorescence* broadly obconical depressed on opening, 7,0 cm in diam., becoming narrowly obconical after pollination; pedunculate, peduncle 0,75—1,0 cm long. *Involucral receptacle* conic depressed, acute 2,0 cm long, 1,5 cm wide. *Involucral bracts* loosely arranged, narrowly lanceolate-linear, drawn out into a long acuminate apex, up to 2,0 cm in length, somewhat incurved; cinereous, beset with long spreading, silky trichomes; pinkish-grey in live state. *Bracteoles* oblanceolate, abruptly acuminate, outer surface of

proximal half densely lanate; apex cinereous, beset with long spreading silky trichomes. *Perianth* 2,5—3,0 cm long, uniformly villous, pale carmine when fresh; strongly incurved in bud. *Perianth tube* 8,0 mm long, glabrous and narrowing proximally, puberulous distally. *Perianth limbs* narrowly lanceolate acute, shortly villous with long silky trichomes sparsely interspersed. *Style* 50,0—60,0 mm long, almost straight, but curved adaxially in the distal region on opening; orange at anthesis, becoming deep crimson with age. *Pollen presenter* ellipsoid-cylindric, 2,5 mm long, 0,75 mm wide, greenish; stigmatic groove terminal. *Hypogynous scales* 3,0 mm long subulate, pale yellow.

Diagnostic Characters: The pubescent, loosely arranged, narrowly lanceolate linear involucral bracts distinguish *L. praemorsum* from all other species in the genus. Further distinguishing characters are the oblong-oblanceolate, petiolate leaves, truncate and praemorse at the apex and the ellipsoid-cylindric pollen presenter.

On the 13th of December 1830, Drège collected this species for the first time on record, growing on the sandy flats near Biedouw. The material of this collection on which Meisner based his description of *L. attenuatum* var. *praemorsum*, appears to have consisted of a few leaves only since he described his type as "fragm. steril in herb. Sonder". Despite a careful search through the Sonder material in Stockholm much of which is annotated in Meisner's hand, the present author was unable to trace this collection. As it was the only collection of *L. praemorsum* made by Drège, the duplicates can be regarded as isotypes. The complete specimen in E. Meyer's herbarium in Berlin that was examined at some stage by Meisner has therefore been selected as the lectotype.

Distribution and Ecology: The distribution range of *L. praemorsum* extends from near Lokenberg in the Calvinia district, southwards to the Gifberg and the Nardouwberg plateau with the most southerly population in the Biedouw—Wupperthal area of the Clanwilliam district.

At all these localities the populations occur in dry situations at elevations of 1 000—2 500 ft., in deep sandy soil derived from weathered Table Mountain Sandstone. *L. praemorsum* is essentially a species peculiar to arid regions receiving a low winter rainfall of 10—15″ p.a. but by virtue of their elevation, these populations probably obtain the benefits of the frequent mists in this area. On the Nardouwberg plateau, large stands occur, consisting of many thousands of plants growing on level sandy flats scattered amongst clumps of *Willdenowia lucaeana* and an occasional shrub of *Leucadendron procerum*, which apart from small annuals and geophytes, comprises the only vegetation cover. It would appear that veld fires are unable to burn very fiercely (if at all) due to the extensive bare sandy areas between the shrubs and tufts of *Willdenowia*. Consequently

most of the specimens of *L. praemorsum* are of considerable age and stature and have developed into small trees. Many specimens attain a height of more than 15 ft. (5 m) and a diameter of more than 20 ft. (7 m) with a trunk diameter of up to 1 ft. (30 cm). After counting the annual growth increments on several specimens, the present author estimates their age to be between 50 and 80 years.

Inflorescences are produced erratically throughout the year (particularly on old senescent plants), although the peak of the flowering period appears to be from July to December.

Specimens Examined:

CAPE

CALVINIA: On the road to Dobbelaars Kop beyond Paalkraal near Lokenberg, Aug., *Williams* 1022 (NBG).

VAN RHYNSDORP: Klaver, Nov., *Austin Roberts* 25092 (PRE); Gifberg, July, *van Lutzenberg* s.n. (NBG 80662).

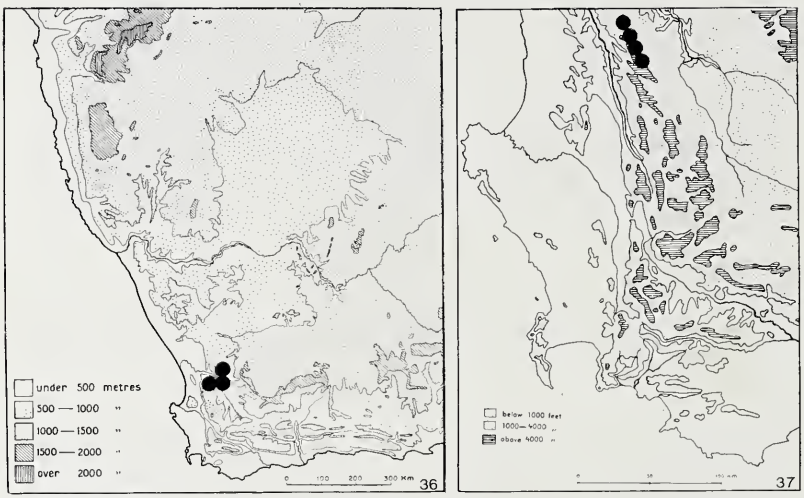
CLANWILLIAM: Nardouw Pass, Aug., *Salter* 3525 (BOL, SAM, PRE, BM, K); Nardouw, Sept., *H. C. Taylor* 5933; Nardouwberg Pass, July, *van Breda* 1600 (PRE, STE, K); Clanwilliam mountains, Sept., *Garside* 4469 (STE, K); Nardouw Pass, Nov., *Middlemost* 1898 (NBG); Vondelingsberg, north of Nardouw, Dec., *Williams* 1140 (NBG); Nardouwsberg, May, *Rycroft* 2239 (NBG); Sept., *Compton* 20000 (NBG); Towards the summit of the Nardouwberg Pass, July, *Williams* 823 (NBG); Sandy flats at Biedouw, 2 500—3 000 ft., 13/12/1830, *Drège* 2416 (P, B, K); Nardouw Plateau, between Vondelingsberg and Syferkop, Aug., *Rourke* 1070 (NBG).

LOCALITY DOUBTFUL: Between Leipoldtville and Graafwater, July, *Leipoldt* 3513 (BOL).

(27) **Leucospermum reflexum** Buek ex Meisn. in DC., Prodr. **14:** 254 (1856); Phillips in Fl. Cap. **5:** 624 (1912). Type: Africa australis, *J. F. Drège*, lectotype in herb. Meisner (NY).
Leucadendron reflexum (Buek ex Meisn.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

ICONES
Flower. Pl. S. Afr. **35** t. 1361 (1962).
S. Eliovson, Proteas for Pleasure: 148 (1965).
M. Vogts, Proteas, Know them and Grow them: 112—116 (1959).
J. bot. Soc. S. Afr. pt. 24: 28 t. 7 (1939).

A large rounded shrub to 4,0 m in diam., with a single main stem at base; bark smooth, grey. *Flowering stems* stiffly erect, 3,0—6,0 mm in diam., covered with a dense indumentum of fine crisped hairs, sparsely interspersed with straight erect trichomes. *Leaves* ascending imbricate; elliptic to oblanceolate-oblong, 2,0—5,5 cm long, 0,5—1,3 cm wide, grey, covered with a dense matted indumentum of fine crisped hairs; apex usually bifid or trifid, occasionally entire.



FIGS. 36 AND 37.
(36) Distribution of *Leucospermum praemorsum* (Meisn.) Phillips.—(37) Distribution of *Leucospermum reflexum* Buek ex Meisn.

Inflorescences solitary, ovoid to globose in young stages, 8,0—10,0 cm in diam.; pedunculate, peduncle 3,0—6,0 cm long. *Involucral receptacle* narrowly cylindric, 2,0—3,5 cm long, 0,5—0,7 cm wide. *Involucral bracts* narrowly deltate, acuminate, 1,0—1,2 cm long, 4,0 mm wide at base; cartilaginous; sparsely sericeous, margins ciliate, apex minutely crinite. *Bracteoles* broadly obtrullate, tightly clasping the perianth, 1,0 em long, 0,6—0,8 cm wide; apex acuminate, patent to recurved; thickly lanate proximally, thinly sericeous distally. *Perianth* 4,0—5,0 cm long, deep orange to crimson. *Perianth tube* 1,0 cm long, glabrous and narrow proximally, puberulous and inflated distally. *Perianth claws* uniformly villous, becoming recurved subterminally. *Perianth limbs* very narrowly lanceolate linear, acute, 5,0—6,0 mm long, 1,5 mm wide, villous. *Anthers* linear subulate 4,0—5,0 long; apical boss sharply subulate 1,0 mm long. *Style* 7,0—7,5 cm long; orange becoming deep crimson. *Pollen presenter* cylindric to subulate, sharply acute, 5,0—6,0 mm long, minutely geniculate at junction with style. *Hypogynous scales* subulate, hyaline, 3,0 mm long.

Diagnostic Characters: The small (2,0—5,0 cm long) elliptic to oblanceolate leaves covered with a dense, crisped, grey indumentum, the cylindrie involucral receptacle and the perianth tube curved at right angles at anthesis, serve to distinguish *L. reflexum* from related species.

On the 11th of December, 1830, J. F. Drège made the first recorded collection of *L. reflexum* at Heuning Vlei in the eastern Cedarberg. This material was given the manuscript name of *L. reflexum* by Buek, a name that was later adopted and validly published by Meisner. As Meisner does not state the location of this type, I propose that the excellent specimen in his personal herbarium labelled "Africa australis J. F. Drège acc. 1840" in his own hand, serve as the lectotype.

Distribution and Ecology: L. reflexum is confined to the eastern part of the Cedarberg between Pakhuis in the north and the Koudeberg—Wupperthal area in the south.

Throughout its range, *L. reflexum* is found only between 3 000 and 6 000 ft. Its range falls within a region of low winter rainfall (10—15″ p.a.) which supports a sparse and rather arid type of fynbos. Nevertheless, at the various localities where the present author has observed *L. reflexum*, the plants have always been growing in comparatively moist situations such as near stream banks or on wet seepage areas, often in association with *Cannamois virgata* and *Pteridium aqualinum*. Information on collectors' labels confirms the view that an adequate supply of moisture is an important requirement of this species despite the aridity of its environment in general. Flowering commences at the end of August and continues into December. Two colour forms are known. Apart from the usual form with styles and perianths brilliant scarlet, a pale yellow form has been recorded from Heuning Vlei.

The Mechanism of Reflexion: In *L. reflexum* the hinged perianth is developed to its fullest extent. Reflexing is brought about by the bending of the perianth tube. In the young bud stage before the elongating style has protruded through the perianth claws, the perianth tube is straight and very slightly inflated distally. By the time the style has protruded through the perianth claws and has arched abaxially, the adaxial surface of the perianth tube has begun to enlarge. The rapid elongation of the cells on the adaxial surface of the perianth tube causes the entire perianth to bend abaxially (i.e. downwards). When reflexing is complete, the upper half of the perianth tube is bent at right angles to the lower half. Concommitantly with the bending of the perianth tube, the syle (which is constricted within the tube) is bent at right angles, 6.0 mm above the ovary. The style is forced into this position by the bending of the turgid perianth tube. At this stage the flower is fully reflexed with the styles adpressed to the peduncle. As the perianth dries, becomes papery, and loses its turgidity in the fruiting stage, the styles are released and become erect again, spreading at right angles to the inflorescence axis instead of being closely adpressed to the peduncle.

Specimens Examined:

CAPE

CLANWILLIAM: Cedarberg, Krakadouw Heights, Oct., *Pocock* 493 (STE); Pakhuis Pass, Oct., *Schroeder* s.n. (STE 19375); Koudeberg, Aug., *Schlechter* 8755 (PRE, GRA, BOL, PH, BM, K, G, S, Z, BR); Pakhuis Pass, Oct., *Bolus* 9079 (BOL, NBG, PRE, NH, K); Koudeberg above Wupperthal, Nov., *Thode* A2134 (PRE, NH, K); Near Crystal Pool, Cedarberg, Sept., *Levyns* 2946 (CT); East of Cedarberg in a vlei, July, *Wurts* 2146 (NBG); Cedarbergen, Oct., *Marloth* 2676 (PRE); Mountains at Krans Kloof near Wupperthal, Sept., *Leipoldt* s.n. (SAM 43639); In the hills near Pakhuis, Oct., *MacOwan* 1946 (SAM, G, BM, K, Z); Krakadouw Heights, Sept., *Barnard* 738 (SAM); Above the forestry hut at Heuning Vlei, Aug., *Rourke* 1077 (NBG); At Heuning Vlei, between Koudeberg and Wupperthal, 3 000—3 500 ft., 11/12/1830, *Drège* 2415 (P, S, B, K, BM, SAM, PRE); At Heuning Vlei, 17/12/1830, *Drège* 2415 (P); Heuning Vlei, Dec., *Kruger* 974 (NBG) yellow form, & *Kruger* 984 (NBG).

Sect. 6. LEUCOSPERMUM

Hypophylloidea Phillips, Fl. Cap. **5**: 612 (1912).
Erect, sprawling or decumbent shrubs. *Leaves* ascending imbricate or secund, oblanceolate cuneate or linear, beset with a dense permanent greyish indumentum of fine crisped hairs. *Perianth* straight in bud, bright yellow, very sweetly scented. *Pollen presenter* clavate or cylindric.

Type: *L. hypophyllocarpodendron* (L.) Druce.

Good characters can be found to separate all the vicarious species within this section but the extent of the variation in the species here delimited as *L. hypophyllocarpodendron* requires further discussion.

Although *L. hypophyllocarpodendron* is a very clearly defined species which may be recognised by its persistent rootstock, trailing stems, secund leaves and very broad involucral bracts, numerous widely divergent forms are grouped under this species. Four principal forms can be recognised:

(1) Glabrous stems and bright green oblanceolate to narrowly cuneate, glabrous leaves;

(2) pubescent stems with grey pubescent, linear canaliculate leaves;

(3) pubescent stems becoming glabrous with glabrescent linear canaliculate leaves;

(4) pubescent stems with pubescent, oblanceolate to very narrowly cuneate leaves.

Only the form with glabrous stems and bright green, glabrous oblanceolate leaves (1) could readily be distinguished within the species. Moreover, it was found to be remarkably uniform throughout its range, showing very little variation. It occurs on the Cape Peninsula and adjacent flats with a few relict populations on the flats at Faure, Stellenbosch and the upper Berg River valley, with an outlying population along the Bredasdorp coast.

However, in the remaining three groups (2, 3 & 4), a wide range of variation was observed. Field studies showed that while small local populations can often

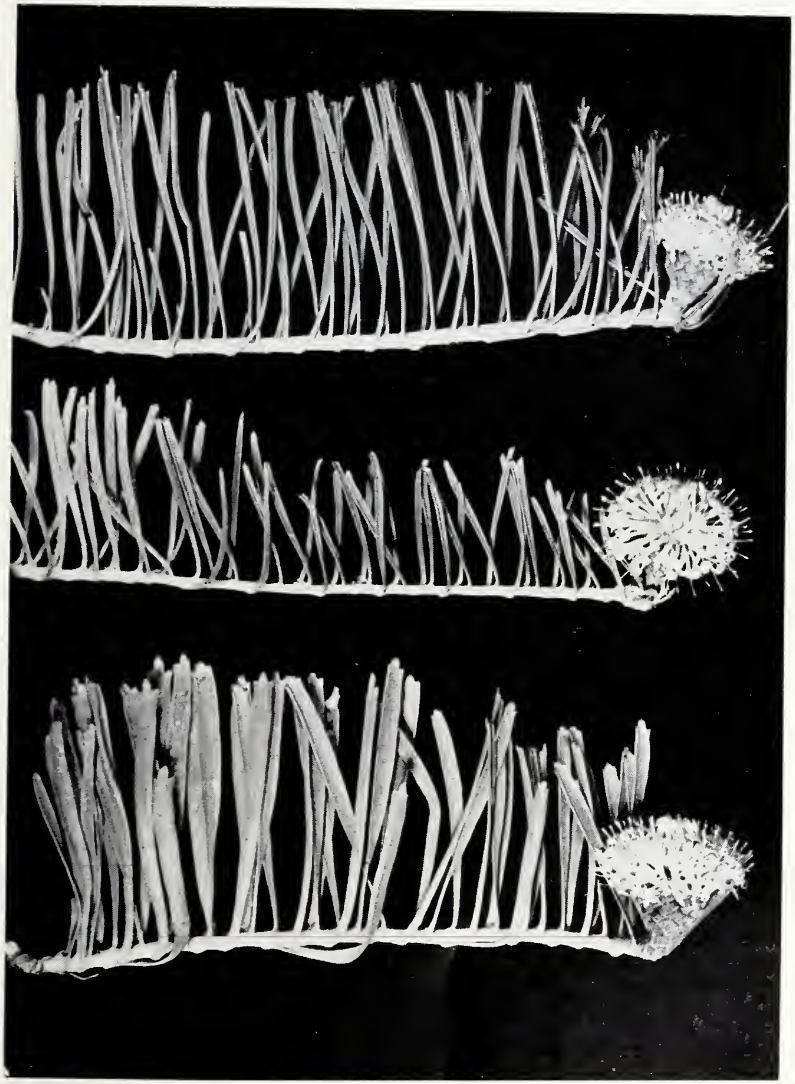


FIG. 38.

The three principal forms of *Leucospermum hypophyllocarpodendron* (L.) Druce ssp. *canaliculatum* (Meisn.) Rourke. All three forms were found growing in close proximity to each other on the southern and western slopes of Katzenberg, near Pella (Malmesbury district). Top: the form with glabrous, linear canaliculate leaves (*Rourke* 1195); Middle: the form with pubescent, linear canaliculate leaves (*Rourke* 1194); Bottom: the form with narrowly oblanceolate pubescent leaves (*Rourke* 1193). (All × $\frac{3}{4}$).

be uniform, these do merge into each other indistinguishably. All are characterised by a fine, greyish crisped pubescence on the stems and leaves which, although normally permanent, tends to rub off with age in form (3) with canaliculate leaves. In such cases the pubescence remains only in the channel formed between the involute leaf margins. On the southern and western slopes of Katzenberg all three forms were found growing in close proximity (fig. 38).

Thus it is only possible to divide *L. hypophyllocarpodendron* into two taxa based on leaf and stem pubescence, which are well demarcated geographically and do not overlap. It is suggested that the first group with glabrous stems and glabrous, consistently oblanceolate leaves, be recognised as ssp. *hypophyllocarpodendron* and those forms with pubescent stems and pubescent leaves (at least at some stage of their development) which may be linear canaliculate to oblanceolate, be recognised as ssp. *canaliculatum*.

(28) **Leucospermum hypophyllocarpodendron** (L.) Druce in Rep. bot. Soc. Exch. Club Br. Isl. **3** (4): 120 (1914).

A prostrate or rarely suberect shrub to 20,0 cm in height, stems trailing along the ground and forming mats 0,5—1,5 m in diam., stems arising from a stout, underground, persistent rootstock. *Flowering stems* 2,0—4,0 mm in diam., pubescent with a fine grey crisped indumentum, glabrescent or glabrous. *Leaves* secund; linear canaliculate to narrowly oblanceolate or narrowly cuneate, 4,0—13,0 cm long, 0,2—1,5 cm wide, apex with 2–4 reddish teeth, occasionally entire; pubescent with a short grey indumentum of fine crisped hairs, occasionally becoming glabrescent to glabrous, or bright green and quite glabrous. *Inflorescences* depressed globose, 3,0—4,0 cm in diam.; pedunculate, peduncle 3,0—5,0 cm long; arising in groups of up to 4, generally at right angles to stem. *Involucral receptacle* conic acute, 1,5 cm long, 0,7—1,0 cm wide. *Involucral bracts* very broadly ovate acute, 4,0—6,0 mm long, 5,0—7,0 mm wide, closely adpressed imbricate, cartilaginous, glabrescent to softly tomentose. *Bracteoles* broadly obtrullate to ovate, acute, 7,0 mm long, 5,0 mm wide, cartilaginous, very thickly lanate proximally, pilose distally. *Perianth* 2,0—2,2 cm long, tubular, slightly adaxially curved in bud; bright yellow. *Perianth tube* 1,0 cm long, minutely pilose but glabrous adaxially. *Perianth claws* strongly coiled at anthesis; the 3 adaxial claws united into a sheath, glabrous, but pilose along sheath margins; abaxial claw pilose. *Perianth limbs* narrowly lanceolate acute, 3,0 mm long, the 3 abaxial limbs villous, adaxial limb glabrescent. *Style* 2,0—2,6 cm long, slender, straight or very slightly adaxially curved; yellow. *Pollen presenter* clavate obtuse 1,5—2,0 mm long, stigmatic groove terminal. *Hypogynous scales* subulate linear, 1,0 mm long, or absent.

Diagnostic Characters: In the section *Leucospermum*, *L. hypophyllocarpodendron* is distinguished by its prostrate growth habit, the trailing stems with secundly arranged linear canaliculate to narrowly oblanceolate leaves which may be pubescent or glabrous and by the broadly ovate involucral bracts, 5,0—7,0 mm wide.

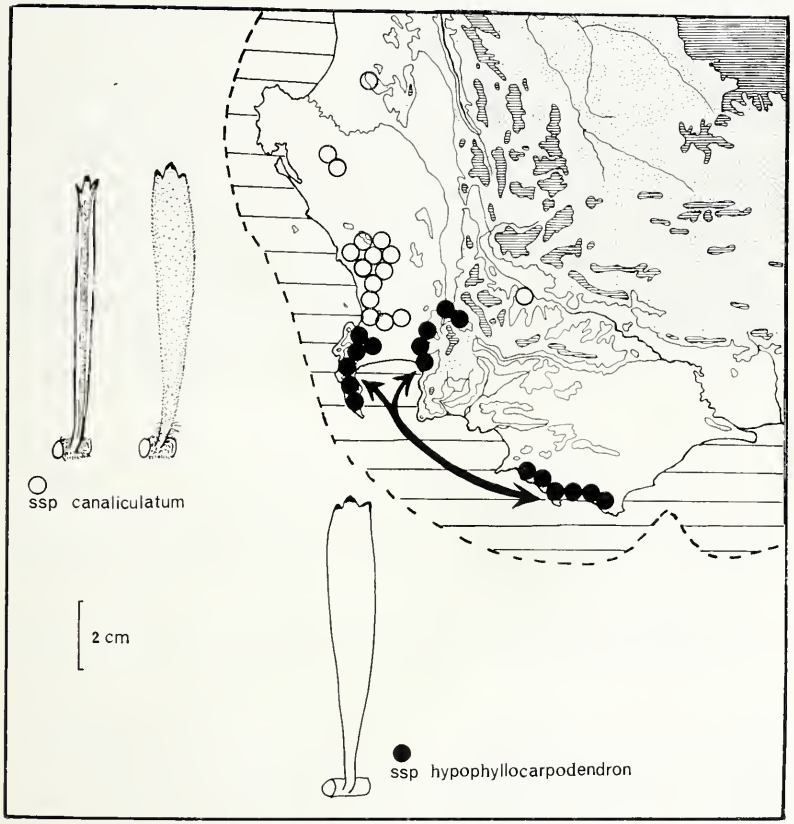


Fig. 39.
Distribution of *Leucospermum hypophyllocarpodendron* (L.) Druce. The range of ssp. *canaliculatum* (Meisn.) Rourke is indicated with open circles and the range of ssp. *hypophyllocarpodendron* with solid circles. The dotted line enclosing the widely hatched area along the coast represents the position of the coastline during the Middle Pleistocene (adapted from Hamilton and Cooke, 1965: 336). The arrows indicate a hypothetical migration route between the Cape Flats and the Bredasdorp Flats during Middle Pleistocene times.

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Key to subspecies

Stems and leaves glabrous, leaves always narrowly oblanceolate to narrowly cuneate

.....ssp. *hypophyllocarpodendron*

Stems and leaves pubescent with a fine grey crisped indumentum occasionally lost with age, leaves linear canaliculate or narrowly oblanceolate to narrowly cuneate

.....ssp. *canaliculatum*

(a) ssp. **hypophyllocarpodendron**

Leucadendron hypophyllocarpodendron L., Sp. Pl. ed 1: 93 (1753). Lectotype: Boerhaave, Ind. Hort. Lugd. Bat (2) t. 198 (1720).

Protea hypophyllocarpodendron (L.) L., Mant. Alt.: 191 (1771).

Protea hypophylla Thunb., Diss. Prot.: 23, 49 (1781),—nom. superfl.

Leucadendrum hypophyllum (Thunb.) Salisb. ex Knight, Cult. Prot.: 56 (1809).

Leucospermum hypophyllum (Thunb.) R. Br. in Trans. Linn. Soc. Lond. **10:** 102 (1810); Roem & Schult., Syst. Veg. **3:** 361 (1818); Meisn. in DC., Prodr. **14:** 257 (1856) excluding var. β and var. γ; Phillips and Stapf in Fl Cap. **5:** 625 (1912); Adamson & Salter, Fl. Cape Penins.: 326 (1950).

Pre Linnaean Citations.

Leucadendros Africana sive Scolymocephalus, angustiori folio, apicibus tridentatis *Pluk., Opera 2 (Almagest.): 212 (1696).*
Thymelaea capitata Rapunculoides Nerii crassioribus foliis, summo apice tridentatis, Aetheopia, coniformi calyce squamata. *Pluk., Opera 3 (Mant.): 181 (1700). Tab. 440 fig. 3. in Pluk., Opera 4 (Amal. Bot.) 1705.*
Scolymocephalus foliis angustis in summitate tridentatis. *Ray, Hist. Plant. tome 3, Dendr.: 9 (1704).*
Conocarpodendron; folio rigido, angusto, apice tridentato, rubro; flore aureo. *Boerh., Ind. Hort. Lugd. Bat. (2) t. 198 (1720).*
Protea foliis lanceolato-linearibus, apice tridentato-callosis. *L., Hort. Cliff.: 29 (1737).*
Protea foliis lanceolatis linearibus, apice tridentato callosis; capitulis aphyllis. *Roy., Prod. Lugd. Bat.: 184 (1740); Wach., Hort. Ultra. (1747).*
Scolymocephalus seu Conocarpodendron folio angusto. *Weinm., Phyt. 4: 294 t. 902 fig. a (1745).*

Stems glabrous to glabrescent, often tinted reddish in the live state. *Leaves* flat, narrowly oblanceolate to narrowly cuneate, glabrous, bright green when fresh. *Hypogynous scales* minute, 0,2 mm long, or absent.

Linnaeus cited four different polynomials when he described *L. hypophyllocarpodendron*, including a reference to a specimen in Clifford's herbarium. Of the four elements in the protologue, only the Boerhaave plate has any significant bearing on the typification of the name since it is only from this plate that Linnaeus could have obtained the information "calycibus turbinatis nudis"

quoted in his original description. The small sterile twig in the Hortus Siccus Cliffortianus was obviously taken from a plant in Clifford's garden but there is no evidence that it ever flowered. Likewise, the other polynomials refer to vegetative parts only. Consequently, Boerhaave's plate appears to be the only acceptable lectotype. This plate depicts a specimen with glabrous oblanceolate leaves and glabrous stems and was said to have occurred on sandy fields at Steenberg, thus clearly identifying the type with a plant from the Cape Peninsula.

Distribution and Ecology: The typical subspecies still occurs on the Cape Peninsula, but only in the southern half as it is now extinct on the flats between Cape Town and Retreat due to urban expansion. Small relict populations survive near Faure, Stellenbosch and in the upper Berg River valley but the most extensive populations occur along the Bredasdorp coast between Franskraal and Brandfontein.

Most populations occur on sandy flats of Tertiary age, at elevations ranging from sea level to 500 ft. but are occasionally found at elevations up to 1 000 ft. on weathered Table Mountain Sandstone. The mature plants are very fire resistant and are able to regenerate new stems from a large subterranean rootstock. The bright yellow, sweetly scented inflorescences are produced between August and January.

Specimens Examined:

CAPE

CAPE: Raapenberg, Cape Flats, *F. Guthrie* 1889 (CT); Cape Flats, *Wallich* 160 (BM); Near Durban Rd., Nov., *MacOwan* 2504 (no. 775 in Herb. Norm.) (SAM, Z, K, G); Cape Flats, *Ecklon* s.n. (M); Cape Flats near Rondebosch, 31/1/1811, *Burchell* 710 (K); Cape Town, Flats *Rehmann* 2086 (BR, Z).

WYNBERG: Near Wynberg, Nov., *MacOwan* 2504 (no. 775 in Herb. Norm.) (GRA, NH, Z, G, BM, K); Flats between Claremont and Kenilworth, Dec., *Schlechter* 59 (Z); Retreat, Nov., *Rogers* (BM, Z, K); Flats west of Zeekoe Vlei, Nov., *Salter* 3999 (BM); Tokai-Westlake Rd., Sept., *Esterhuysen* 31106 (BOL).

SIMONSTOWN: Between Buffels Bay and Cape Point, Oct., *Salter* 3881 (BM); Near Kommetjie, Dec., *Phillips* s.n. (PRE); Kommetjie, Nov., *Galpin* 4467 (PRE, K); Imfoffs Gift, Aug., *Kies* 136 (NBG); Bonteberg, Sept., *Compton* 9349 (NBG); Smitswinkel, Feb., *Middlemost* 1671 (NBG); Olifants Bos, Aug., *Compton* 15843 (NBG); Kommetjie Hills, Sept., *Barker* 5899 (NBG); Cape Point, Nov., *Compton* 12533 (NBG); Between Smith's Farm and Vasco da Gama, Dec., *Salter* 8515 (CT); Fish Hoek, Aug., *Page* s.n. herb. Guthrie (CT); Kalk Bay, Sept. 1886, *Alexander Prior* s.n. (K); Between Smith's Farm and Cape Point, *Phillips* 3762 (SAM); Modderdam, Oct., *Barker* 3884 (NBG, BOL); Smith's Farm, Oct., *Hutchinson* 658 (K, BOL, BM, PRE); Mountains around Simonstown, Oct., *Bolus* 4688 (BOL, K); Fish Hoek, Jan., *Rodgers* 16068 (G); Cape Point, Phillips 521 (PRE, K); Fish Hoek, Aug., *Thode* 8429 (STE).

STELLENBOSCH: Between Sir Lowry's Pass and Jonkershoek, *Burchell* 8302 (K); Stellenbosch flats, Aug., *Strey* 460 (PRE); Zeekoe Vlei Farm, near Faure, Nov., *Rourke* 995 (NBG).

PAARL: Berg River, near Paarl, 5/1/1829, *Drège* 1469 (P, SAM); Belgravia, Paarl Rd., *de Villiers* s.n. (BOL); French Hoek, Oct., *Roberts* s.n. sub STE 16841 (STE); French Hoek, Oct., *Phillips* 1269 (SAM); Wemmershoek, Nov., *Baker* 311 (NBG)

BREDASDORP: Soetanysberg, Nov., *Smith* 5034 (PRE); Brandfontein, Sept., *Smith* 3127 (PRE); Rietfontein Poort, Dec., *Schlechter* 9684 (GRA, Z, PRE); Near Elim, Dec., *Bolus* 8584 (BOL, K); Springfield estate, *Stokoe* s.n. (SAM); Groenkloof, above Pearly Beach, Aug., *Rourke* 1085 (NBG); Soetanysberg, Dec., *Rourke* 1008 (NBG); Flats above Pearly Beach, Aug., *Rourke* 536 (NBG); Heidehof, near Uilenkraal River, Oct., *Rourke* 1012 (NBG).

(b) ssp. **canaliculatum** (Buek ex Meisn.) Rourke, comb. nov. et stat. nov.

Leucospermum canaliculatum Buek in Drège, Zwei Pfl. Geog. Docum. 112, 113, 199 (1843),—nom. nud.

Leucospermum hypophyllum (Thunb.) R. Br. var. *canaliculatum* Buek ex Meisn. in DC., Prodr. **14:** 257 (1856). Type: Between Dassenberg and Paardeberg, 18/2/1829, *Drège* 1470b (Lectotype in herb. Meisn. NY; isotypes G, B, P, SAM).

Leucospermum hypophyllum (Thunb.) R. Br. var. *angustifolium* Klotzsch in Krauss, Flora **28:** 76 (1845),—nom. nud.

Leucospermum hypophyllum (Thunb.) R. Br. var. *stenophyllum* Meisn. in DC., Prodr. **14:** 257 (1856). Type: In herb. DC., comm. ex herb. Delessert (not found).

Stems pubescent, beset with a fine greyish crisped indumentum. *Leaves* linear canaliculate, to narrowly oblanceolate cuneate, pubescent, with a greyish indumentum of fine crisped hairs; usually permanently pubescent but occasionally with the indumentum rubbing off causing leaves to become glabrous or glabrescent later.

Distribution and Ecology: Apart from an outlying population near Brandvlei, Worcester, this subspecies is confined to the "sandveld" of the Western Cape coast, ranging from Milnerton, Kuils River and Kraaifontein in the south to Mamre, Darling, Hopefield and Piketberg in the north.

The ssp. *canaliculatum* occurs in habitats very similar to those of the typical subspecies, that is, always on deep white sandy soils of partly stabilised Tertiary or Recent deposits. However, the environment is slightly drier, with a mean annual rainfall of 15—20″ p.a. As with the typical subspecies, it is very fire resistant and flowers from August to January.

Specimens Examined:

CAPE

PIKETBERG: Piketberg mountain, *Krige* s.n. sub STE 10528 (STE); Mountain above Aurora, Aug., *Rourke* 1059 (NBG).

HOPEFIELD: Field near Hopefield, Sept., *Letty* 6 (PRE); Hopefield, Oct., *Compton* 15117 (NBG).

MALMESBURY: Southern part of Dassenberg, Sept., *Pillans* 6871 (BOL); Kalabaskraal, Feb., *Grobler* 883 (STE); Buffelsrivier, Oct., *H. C. Taylor* 4153 (STE); Kalabaskraal, April, *van der Merwe* 7 (STE); Near Darling, Sept., *Parker* 4631 (PH, PRE, K); In arenosis Groenkloof, Oct., *Zeyher* s.n. (NH); Sandy places, Groenkloof, Oct., *Bolus* 4325 (BOL); Mamre Rd., *Leighton* 1847 (PRE); Between Darling and Malmesbury, Oct., *van Breda* 1052 (PRE); Between Malmesbury and Mamre Rd. station, *Garside* 4580 (K); Pella turn off, Oct., *Barker* 10355 (NBG); Near Darling, Aug., *Compton* 7508 (NBG); Melkbos Rd., Aug., *Compton* 15869 (NBG); Blaauwberg Rd., July, *Barker* 390 (NBG); Melkbosstrand Rd., Sept., *Acocks* 2536 (S); Between Groenkloof & Dassenberg, Sept., *Drège* s.n. (S); Between Dassenberg and Paardeberg, 18/2/1829, *Drège* 1470b (G, P, B, SAM, NY); At Dassenberg, 19/9/1828, *Drège* s.n. (P, S); Darling, Sept., *Bayliss* 1662 (Z); Zwartland, Nov., *Pappe* s.n. sub SAM 19635 (SAM); Mamre Flats, Oct., *Compton* 13877 (NBG, PRE); Near Melkbos Strand, Sept., *Compton* 9340 (NBG); Flats east of Melkbos, Aug., *Salter* 3549 (BM, K); Mamre dunes, Sept., *Garside* 4651 (K); Klein Springfontein, Sept., *Rourke* 1095 (NBG); Burghers Post, E. slopes of Dassenberg, Aug., *Rourke* 502 (NBG); S. slopes of Katzenberg, Aug., *Rourke* 1193 and 1194 (NBG); West of Pella, Aug., *Rourke* 1195 (NBG).

BELLVILLE: Rietvlei, Sept., *MacOwan* s.n. sub SAM 13584 (SAM); 4 miles north of Milnerton, Nov., *L. Bolus* s.n. sub BOL 18317 (BOL); Rietvlei, Nov., *Ecklon & Zeyher* 1465 (SAM, K, G); Along Koeberg Rd., Nov., *Forbes* 228 (NH); Between Tygerberg and Simonsberg, 7/10/1829, *Drège* s.n. (P); Mulder's Vlei, Jan., *Pillans* 10400 (BR); Near Kraaifontein, Nov., *Salter* 3987 (BM, K); Kraaifontein, Nov., *Wilman* 950 (BOL); Kuils River, Sept., *Garside* 35 (K); Kraaifontein, Dec., *Young* 162 (PRE); Kuils River, Sept., *Lewis Grant* 2532 (PRE); Halfway House on Rd. to Stellenbosch, 20/8/1846, *Alexander Prior* s.n. (PRE).

WORCESTER: Brandvlei winery, Oct., *van der Merwe* 25–64 (STE, K, PRE); Near Brandvlei, Oct., *Williams* 512 (BOL); De Grip, Worcester, *Walters* 1015 (PRE, K); Kweek Kraal, S.W. of Worcester, Oct., *Hardy & Bayliss* 1016 (PRE, K).

(29) **Leucospermum tomentosum** (Thunb.) R. Br. in Trans. Linn. Soc. Lond. **10:** 101 (1810); Phillips in Fl. Cap. **5:** 626 (1912).
Protea tomentosa Thunb., Diss. Prot.: 24 (1781). Lectotype: Cap. b. spei, *Thunberg* s.n., sheet no. 2992 in herb. Thunberg (UPS).
Leucadendrum tomentosum (Thunb.) Salisb. ex Knight in Knight, Cult. Prot.: 57 (1809).
Leucadendron tomentosum (Thunb.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).
Leucospermum ecklonii Buek, in Drège Zwei Pfl. Docum.: 113, 199 (1844) —nom. nud.

An erect to semi-erect shrub 0,5—1,0 m in diam., 40,0 cm to 1,0 m in height. *Basal branches* stout and woody, 2,0—5,0 cm in diam., tending to spread horizontally. *Flowering stems* erect to horizontally spreading, 4,0—6,0 mm in diam., covered with a dense indumentum of short crisped hairs interspersed with long, slender, erect trichomes. *Leaves* linear to linear-spathulate, 4,5—6,0 cm long, 3,0—5,0 mm wide; margins involute causing leaves to be broadly canaliculate; loosely ascending imbricate on upper branches, occasionally subsecund on lowermost trailing branches; apex entire or with up to 3 teeth. Leaves covered with a dense canescent indumentum of short, closely adpressed crisped hairs. *Inflorescences* sessile, globose, 3,0—3,5 cm in diam., solitary, or

with 3 to 4 inflorescences per flowering shoot. *Involucral receptacle* conic-depressed, 1,3 cm long, 1,0 cm wide. *Involucral bracts* lanceolate-acute 5,0 mm long, 3,0 mm wide, cartilaginous, very closely adpressed imbricate; shortly tomentose, the apex crinite, cinereous. *Bracteoles* linear-obtrullate, 5,0—7,0 mm long, 1,0—2,0 mm wide, apex acute to acuminate, margins ciliate, outer surface tomentose. *Perianth* 2,0 cm long, straight in bud, tubular, deep yellow throughout; the abaxial and 2 lateral perianth claws sparsely pilose, the adaxial claw glabrous. *Perianth tube* 4,0—5,0 mm long, glabrous, slightly laterally compressed. *Perianth limbs* lanceolate acute, 2,0—3,0 mm long, barely differentiated from the perianth claws, outer surface sparsely hirsute to glabrescent. *Style* straight, slender, 1,7—2,0 cm long, yellow. *Pollen presenter* cylindric to narrowly ellipsoid 1,5—2,0 mm long; stigmatic groove terminal. *Hypogynous scales* linear-subulate, 1,0 mm long, hyaline.

Diagnostic Characters: L. tomentosum is the only erect species in the section *Leucospermum* which has a persistent rootstock. Its small, cartilaginous, tightly imbricate involucral bracts, shortly tomentose on the outer surface, and linear canaliculate leaves distinguish it from other related species.

Thunberg was apparently the first to observe, collect and describe this species, probably on his first journey northwards. On the 7th of September 1772, after having left Jan Besis Kraal (the present day Milnerton, a suburb of Cape Town) he notes that:

> "all over the sandy fields the protea hypophylla was seen creeping and procumbent, with its leaves standing erect on each side of it. Near Eland's Fontain a plant of this species was standing upright like a bush, much resembling the former, but with broader leaves".

The upright plant which Thunberg refers to is clearly *L. tomentosum*. Thunberg describes the leaves of *Protea tomentosa* as "linearia". For this reason, the material mounted on the sheet labelled *Protea tomentosa* β in Thunberg's herbarium has been selected as the lectotype since it has linear leaves and matches his description perfetly. Sheet no. 2991 labelled *Protea tomentosa* α in Thunberg's handwriting cannot possibly be the type as it has oval-oblong leaves.

Distribution and Ecology: The most southerly populations of *L. tomentosum* occur at Bok Bay and the most northerly on the sandy flats between Hopefield and Vredenburg.

L. tomentosum is a species characteristic of the "sandveld" along the Atlantic coastline. Apart from an exceptionally isolated population at Mud River ($\pm$6



FIG. 40.
Part of the rootstock of *Leucospermum tomentosum* (Thumb.) R. Br. showing the development of new shoots (from *Rourke* 1113). Life size.

miles from the coast), this species seldom occurs further inland than 3 miles from the coast. The entire area receives a rather low winter rainfall of 10—15″ p.a. The plants tend to be widely scattered on bare sandy areas in between large clumps of *Restionaceae*, *Passerina* and *Metalasia*. An erect to sub-erect growth habit is developed but as the plants age they usually form low spreading mats 1—3 m in diam. and 0,75 m tall. *L. tomentosum* is a fairly fire resistant species. Regeneration takes place from underground stems. The lowermost branches of the adult plants droop onto the soil and soon become buried in the sand, several inches below the surface with the terminal leafy shoots projecting above the soil. From these stout underground stems covered with corky bark, new shoots regenerate when the aerial parts of the plant have been burnt off. Flowering takes place between June and November. The bright yellow inflorescences are very sweetly scented.

Specimens Examined:

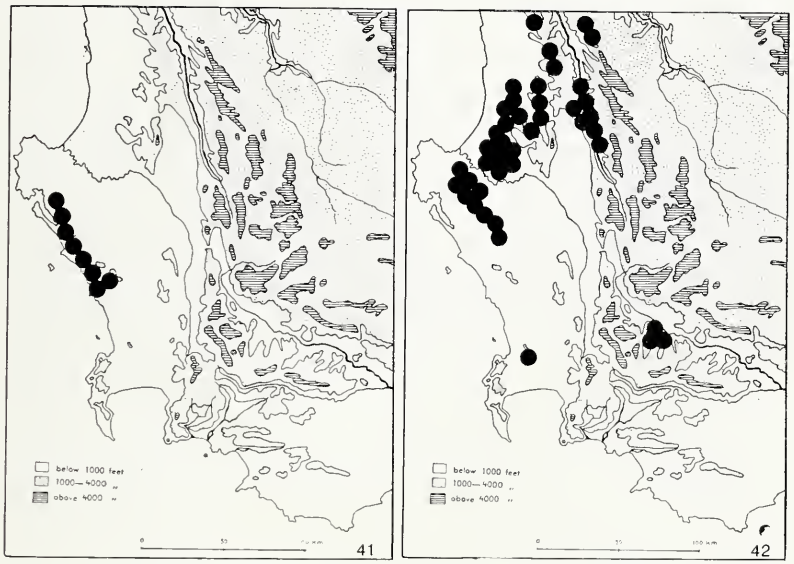
CAPE

MALMESBURY: 2 miles from the coast at Ysterfontein on Darling Road, Aug., *Garside* 4773 (K); In arenosis Groenkloof, Oct., *Pappe* s.n. (SAM 19607); 1 mile east of Ysterfontein, Aug., *H. Hall* 944 (NBG); Darling, Dec., *Pole Evans* s.n. (SAM 51334); Groenkloof, 500 ft. 23/9/1827, *Drège* 1468 (P); Zonquasfontein 12,5 miles from Darling, June, *Boucher* 77 (STE); 4 miles east of Ysterfontein, Aug., *Salter* 6227 (BOL, BM, NY); Sandy flats near Ysterfontein, Feb., *Acocks and Hafstrom* 2112 (PRE); Mamre, June, *Acocks* 14521 (PRE); Ysterfontein, Dec., *Pole Evans* 4384 (PRE, NBG, K); Aug., *Marloth* 4035 (PRE); Aug., *Gillet* 3120 (BOL); Sandy flats between Darling and Ysterfontein near Versveld reserve, Sept., *Rourke* 15 (BOL, NBG); Sandy flats near the farm Geelbek, Sept., *Rourke* 16 (BOL, NBG); Half a mile along the Donkergat road from Ysterfontein, Aug., *Williams* 837 (NBG); Blombosfontein, north of Ysterfontein, Sept., *Rourke* 586 (NBG); On the farm Jacobus Kraal, 14 miles south of Darling, Aug., *Rourke* 1054 (NBG); Near Leerbaai, about 2 miles north of Bokbaai, Sept., *Rourke* 1113 (NBG); Geelbek, Aug., *Compton* 19888 (NBG); Geelbek road, Sept., *Compton* 24386 (NBG); Between Pampoen Vlei and Mud River near Darling, Sept., *Rourke* 1093 (NBG); Between Ysterfontein and Darling, Aug., *Barker* 389 (NBG); Buffelsrivier, strandveld near Bokbaai, Oct., *H. C. Taylor* 4153 (PRE); Bokbaai, coastal macchia, *H. C. Taylor* 5012 (PRE); Bok Point, Sept., *Compton* 9383 (NBG); Bok Bay, Sept., *Compton* 6775 (NBG); Swartwater farm, 8 miles N.W. of Darling, Sept., *Rourke* 1205 (NBG).

HOPEFIELD: In arenosis prope Hopefield, Sept., *Schlechter* 5300 (Z); Hopefield, Oct., *Marloth* 11540 (STE, PRE); Between Vredenburg and Hopefield, Sept., *Hutchinson* 304 (PRE, K, BM, BOL, GRA); Sandy flats between Hopefield and Vredenburg, Oct., *Pillans* 6993 (BOL); Between Hopefield and fossil site, Oct., *Middelmann* 1 (NBG); 3 miles west of Hopefield, Nov., *H. Hall* 857 (NBG); Sandy flats at Saldanha Bay, 200 ft., 26/9/1828, *Drège* 1470c (P); Grootfontein, vicinity of Hopefield, Sept., 1886, *Bachmann* 1298 (Z); Near Theefontein, vicinity of Hopefield, Sept. 1887, *Bachmann* 2132 (Z).

WITHOUT PRECISE LOCALITY: Cap. b. spei, *Niven* 50 in herb. J. E. Smith (LINN); "Erect shrub 4 or 5 feet high, sandy plains everywhere" *Niven* s.n. (K); Cap. b. spei, *Thunberg* s.n., sheet no. 2992 in herb. Thunberg (UPS); Cap. b. spei *Ekeberg* s.n. in herb. Bergius (SBT).

LOCALITY DOUBTFUL: Swellendam, Oct., *Pappe* s.n. (SAM 19634); H. Holland, Oct., Nov., *Verreaux* anno 1831, (G).



FIGS. 41 AND 42.
(41) Distribution of *Leucospermum tomentosum* (Thunb.) R. Br.—(42) Distribution of *Leucospermum rodolentum* (Salisb. ex Knight) Rourke.

(30) **Leucospermum rodolentum** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **35:** 323 (1969).
Leucadendrum rodolentum Salisb. ex Knight in Knight, Cult. Prot.: 58 (1809). Iconotype: Andr., Bot. Repos.: t. 294 (1803).
Protea candicans Andr., Bot. Repos.: t. 294 (1803),—non Thunb. (1800).
Leucospermum candicans (Andr.) Sweet in Sweet, Hort. Suburb. Lond.: 21 (1818); London, Encycl. of Plants ed 1: 82 (1829); Phillips and Stapf in Fl. Cap. **5:** 628 (1912).

Erect to spreading shrubs, to 3,0 m in height, 4,0 m in diam.; with a single main stem at base; trunk 8,0—14,0 cm in diam., bark smooth grey. *Flowering stems* erect, ascending, 5,0—7,0 mm in diam., covered with a dense grey indumentum of fine crisped hairs. *Leaves* elliptic to cuneate 0,7—1,5 cm wide, 4,0—6,5 cm long, obtuse or attenuate at base; canescent, covered with a fine, dense indumentum of short, crisped hairs; apex 3—6 dentate, truncate or rounded. *Inflorescences* globose, 3,0—3,5 cm in diam.; sessile to pedunculate, peduncle 5,0 mm long; 2, 3 or 4 nate, seldom solitary. *Involucral receptacle*

broadly conic depressed, 1,0 cm long, 0,7 cm wide. *Involucral bracts* ovate acute 5,0—7,0 mm long, 2,0—3,0 mm wide, tightly imbricate, cartilaginous, cinereous. *Bracteoles* narrowly lanceolate acuminate, 2,0 cm long, 2,0 mm wide, clasping the perianth, thickly lanate proximally, apex puberulous, carmine, margins ciliate. *Perianth* straight and cylindric in bud, 1,5—2,5 cm long, deep yellow, limbs tinged with green in bud. *Perianth tube* 5,0 mm long, hyaline, cylindric, glabrous. *Perianth claws* recurved in the upper half, the 3 adaxial claws glabrescent, margins thinly sericeous; abaxial claw thinly sericeous. *Perianth limbs* lanceolate acute, 3,0 mm long, 1,0 mm wide, very sparsely sericeous. *Style* straight, 1,5—2,5 cm long, tapering subterminally, occasionally very slightly abaxially arcuate. *Pollen presenter* clavate to cylindric-obtuse, 2,0 mm long, stigmatic groove terminal. *Hypogynous scales* subulate, 1,0 mm long, hyaline.

Diagnostic Characters: L. rodolentum may be distinguished from related taxa by its tall, erect growth habit (to 3,0 m) and its very densely canescent, elliptic to cuneate leaves 0,7—1,5 cm broad.

The earliest known account of this species was published by Andrews. This was based on living specimens that had flowered in Hibbert's conservatory at Clapham, in 1802 and had probably been raised from seeds gathered by Masson. As the name *Protea candicans* Andr. is a later homonym of *P. candicans* Thunb., the new name "rodolentum" proposed by Salisbury, has been adopted.

Distribution and Ecology: Apart from an outlying population south of Brandvlei, the main area of distribution extends from Darling, northwards through the districts of Hopefield, Piketberg and Clanwilliam. The most northerly populations are found on the Heerenlogementberg and the Nardouw Pass. In 1966 Mrs. E. Powrie discovered a single plant surviving on a relict area of veld between Brakenfell and Kraaifontein, about 12 miles east of Cape Town and in August 1884, Marloth collected specimens near Salt River, even closer to Cape Town. However, this species must now be considered extinct in both these localities due to urban expansion.

L. rodolentum is a prominent species in Western Cape coastal sandveld. It is frequent on level sandy flats, usually growing in association with *Leucadendron pubescens*, *Willendowia* sp., and other Restionaceae. Most populations are found between sea level and 800 ft., very few having been recorded above 1 000 ft. The edaphic requirements of this species are very specific in that it occurs only on loose surface deposits of sand (very often stabilised drift sand), that are of Tertiary or Recent origin. The entire distribution range falls closely within the 15—20″ isohyet, although at most localities the mean annual rainfall seldom exceeds 15″ p.a. Flowering takes place from August to November when the bright yellow, very sweetly scented inflorescences are produced.

Specimens Examined:

CAPE

VAN RHYNSDORP: Among hills south of Heerenlogementberg, Aug., *Rourke* 1064 (NBG).

CLANWILLIAM: Zeekoe vlei, Sept., *Schlechter* 8579 (NBG, S, G, GRA, BOL, Z, BR, PRE, PH, K, BM); Grey's Pass, Sept., *Marloth* 2736 (PRE); Nardouw Pass, Sept., *Salter* 3616 (BOL, K, BM); Oliphants river valley, opposite warm baths, Sept., *Stephens* 6920 (BOL, K); Between Citrusdal and Keerom, Dec., *Esterhuysen* 17944 (BOL); Zeekoe vlei, Aug., *Compton* 4343 (BOL, NBG); One mile north of Keerom, Nov., *Pillans* 8695 (BOL); Zeekoe vlei, Oct., *Levyns* 1203 (CT); Near Modderfontein, Aug., *Schlechter* 4973 (Z); Five miles west of Clanwilliam on Lamberts bay road, July, *Lewis* 2592 (SAM); Nardouw Pass, Sept., *Lewis* 2593 (SAM); Zandberg, Langvlei, 500 ft., 17/7/1830, *Drège* 1468c (P); Sandy flats at Oliphants river, 27/11/1828, *Drège* 1468a (P); Four miles north of Paleisheuvel, Sept., *Hall* 1009 (NBG); Eight miles south of Clanwilliam, July, *Booysen* 28 (NBG); Ten miles N.E. of Clanwilliam, April, *Booysen* 4 (NBG); Boekenberg north of Paleisheuvel, July, *Williams* 812 (NBG); Nardouw Pass, Aug., *Rourke* 1074 (NBG); Between Paleisheuvel & Leipoldtville, Oct., *Werdermann & Oberdieck* 480 (K, PRE); Along the Clanwilliam—Citrusdal Rd., July, *van Breda* 1626 (PRE, K).

PIKETBERG: A few miles west of Sauer, Sept., *Wilman* 866 (PRE); Three miles west by north of Sauer, *Acocks* 14530 (PRE); Sandy soil east of the base of Bokloof, Oct., *Pillans* 7821 (BOL); Between Sauer and Velddrif, June, *Horrocks* 178 (NBG); Mountains above Aurora, Nov., *Williams* 1361 (NBG); Het Kruis, Sept., *Compton* 15024 (NBG); Between Aurora and Velddrif, Aug., *Rycroft* 2127 (NBG); Near Aurora, Aug., *Rourke* 1058 (NBG); Het Kruis, Dec., *Grobler* 48 (STE).

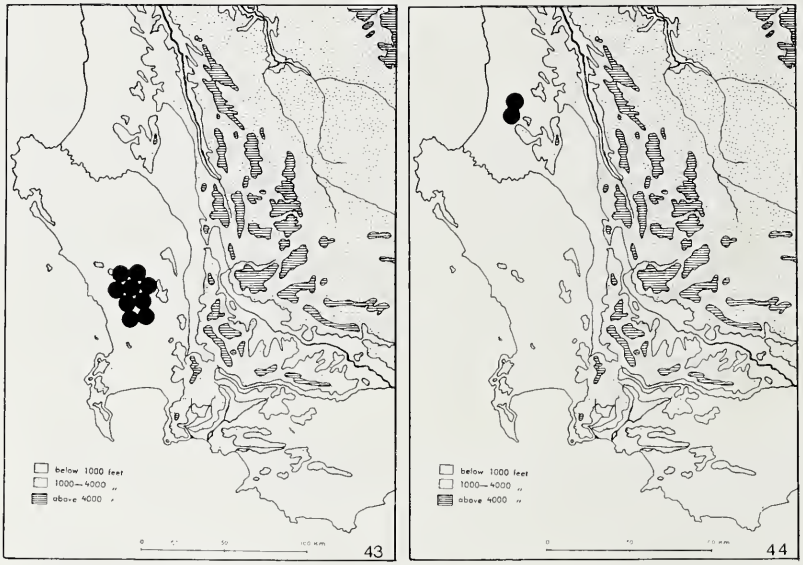
HOPEFIELD: Elandsfontein, Hopefield, *Jordaan* T 1254 (STE); In arenosis prope Hopefield, Sept., *Bolus* 12816 (PRE, BOL, GRA, NH); One mile from Hopefield, *Clarkson* 373 (NU); In arenosis Hopefield, Nov., *Schlechter* 5313 (GRA, BOL, Z); Between Darling and Hopefield, Sept., *Hutchinson* 256 (K, BOL, PRE); Road to Saldanha bay near Hopefield, Oct. 1885, *Bachmann* 1299 (Z); Vicinity of Hopefield, Matjiesfontein and Hazenkraal, Sept. 1886, *Bachmann* 1300 (Z); Hopefield, Aug., *Hall* 748 (NBG); Hopefield, Sept., *Compton* 15968 (NBG); Veld near Hopefield, Oct., *Garside* 1605 (K).

MALMESBURY: Darling, sandy flats, Sept., *H. C. Taylor* 1544 (NBG, BOL); Near Darling, Sept., *Levyns* 3258 (CT); Between Darling and Hopefield, July, *Gill* 37 (NBG); Near Darling, Aug., *Compton* 7794 (NBG); Near Groen River, about 7 miles N.W. of Darling, Aug., *Rourke* 1056 (NBG).

WORCESTER: De Grip, Sept., *Walters* 1016 (PRE); Moordkuil, April, *van Rensburg* 176 (STE); Kweek Kraal, S.W. of Worcester, Oct., *Hardy & Bayliss* 1017 (PRE, STE, K); Brandvlei, Jan., *Schlechter* 9921 (K, BM, PRE, PH, BOL, BR, Z, G, S); Near Brandvlei, *Stokoe* 1196 (PRE); Spes Bona, between Worcester & Villiersdorp, Jan., *Compton* 1665 (BOL, NBG); Between Worcester and Stettyn, Sept., *Rycroft* 1731 (NBG); Moordkuil, a few miles south of Brandvlei, Sept., *Rourke* 1119 (NBG).

BELLVILLE: South of old national rd., between Brackenfell and Kraaifontein, Aug. & June, *Powrie* 16, 26 (NBG); Cape flats near Salt River, Aug., *Marloth* 157 (SAM, PRE).

WITHOUT PRECISE LOCALITY: Cape, "Sandy places everywhere", *Niven* 50 (PH); Cape of Good Hope, *Thunberg* s.n. in herb. Bergius (SBT); Cape of Good Hope, *Thunberg* s.n., sheet 2991 in herb. Thunberg (UPS).



FIGS. 43 AND 44.
(43) Distribution of *Leucospermum parile* (Salisb. ex Knight) Sweet.—(44) Distribution of *Leucospermum arenarium* Rycroft.

(31) **Leucospermum parile** (Salisb. ex Knight) Sweet in Sweet, Hortus Suburbanus Londinensis: 21 (1818); Phillips in Fl. Cap. **5:** 628 (1912).
Leucadendrum parile Salisb. ex Knight in Knight, Cult. Prot.: 57 (1809). Type: "Sandy plains near Paardeberg. Hibbert's garden Parile m.s. June 1805", *Niven* s.n., holotype in herb. R. A. Salisbury (K).
Leucospermum dregei Phillips in Kew Bull. **1910:** 331 (1910)—nom superfl.

An erect to semi-erect rounded shrub, to 1,5 m in height, with a single stout main stem; lower branches often spreading along the ground. *Flowering stems* erect, terete, villous. Leaves loosely ascending-imbricate; linear to oblong-linear, 4,0—6,0 cm long, 6,0—8,0 mm broad; covered with a short, dense canescent indumentum of short crisped hairs; apex entire or up to 3 toothed. *Inflorescences* globose to depressed globose, 3,0—3,5 cm in diam., sessile to subsessile; occasionally solitary, usually with two to six inflorescences clustered in the axils of the uppermost leaves of the flowering stem. *Involucral receptacle* broadly conical to conical-depressed, acute, 1,4 cm long, 1,0 cm wide. *Involucral*

bracts glabrous to glabrescent, ovate-acuminate, the acuminate apex patent to subsquarrose; paleaceous to papyraceous in texture, margins occasionally ciliate and the apex shortly crinite. Bracts 1,0 cm long, 0,5 cm wide. *Bracteoles* lanceolate-acuminate, 1,0 cm long, 0,3 cm wide, lanate proximally on outer surface, glabrous distally, apex crinite. *Perianth* straight at anthesis 1,5—2,0 cm long, yellow. *Perianth tube* glabrous, cylindric, slightly compressed laterally 4,0 mm long. *Perianth claws* 0,9—1,2 cm long, the median posticous claw glabrous, the anticous claw and margins of the two lateral posticous claws pubescent. *Perianth limbs* narrowly-lanceolate, 4,0 mm long; the posticous limb glabrous the three anticous limbs sparsely sericeous. *Style* straight 1,5—2,0 cm long. *Hypogynous scales* 1,5 mm long, hyaline, subulate.

Diagnostic Characters: Among the species of the section *Leucospermum* with linear–oblong leaves and an erect growth habit, *L. parile* is distinguished by its slightly patent to subsquarrose paleaceous to papyraceous involucral bracts, reddish brown in colour and glabrous to glabrescent on the outer surface.

A specimen in the British Museum collected by Francis Masson is probably the first recorded collection of *L. parile*. There is a strong possibility that Masson dispatched seeds as well as herbarium material to England since both Sweet (1818: 21) and Loudon (1829: 82) in their horticultural textbooks record that this species was introduced into England in 1789. Further evidence that it was cultivated in England comes from a note in R. A. Salisbury's handwriting on the type specimen at Kew, reading: "Hibbert's garden Parile ms June 1805". It was raised from seed collected by Niven on the "sandy plains near Paardeberg" (Malmesbury) at which locality it may still be found growing today.

Distribution and Ecology: L. parile is endemic to the Malmesbury district where it occurs within a relatively small area bounded by Mamre Road station (Klipfontein farm) and Abbotsdale in the north, Kalabaskraal in the south and Dassenberg in the west.

This species grows on sandy flats in the Malmesbury "sandveld" at elevations of 100—500 ft., in an area receiving a winter rainfall of 15—20″ p.a. It grows exclusively on white, fairly fine grained sandy soils which are almost completely devoid of organic matter. This soil type is Tertiary to Recent in age and supports a typical "sandveld" vegetation cover consisting mainly of low, tufted *Restionaceae*, *Passerina spp.*, *Serruria spp.*, *Cryptadenia spp.* and various *Ericaceae*. At Katzenberg and Burgher's Post, large dense colonies of *L. parile* still survive but at most other places the populations have been destroyed by agricultural development and the species only survives on uncultivated road verges. The rich yellow, highly perfumed inflorescences are produced between July and November.

Specimens Examined:

CAPE

MALMESBURY: In arenosis depressis prope Groenekloof, Oct., *Bolus* 4324 (BOL, BM, K); N.E. base of Dassenberg, Sept., *Pillans* 6872 & 6873 (BOL); Flats south of Mamre, Aug., *Salter* 3572 B; Dassenberg, 400 ft., 19/9/1828, *Drège* 1468a (P); Groenekloof, Klipberg 500 ft., 23/9/1827, *Drège* 1468b (P); Between Groenekloof and Kalabaskraal, 500 ft., 28/7/1827, *Drège* 1468c (P); Green river near Malmesbury, Aug., *Levyns* 2644 (CT); Mamre road, Oct., *Wasserfall* 1012 (PRE, K); Kalabaskraal, Oct., *Herre* s.n. (STE 26757); Between Groenekloof and Dassenberg, *Drège* s.n. (NY, PRE, SAM, K); Burghers Post farm, Aug., *Rourke* 503 (NBG); Sandy flats between Katzenberg and Dassenberg, Oct., *Rourke* 934 (NBG); A few miles west of Kalabaskraal, Aug., *Rourke* 1055 (NBG); Abbotsdale, about 2 miles S.W. of Malmesbury, Aug., *Rourke* 1078 (NBG); Mamre Road, July, *Barker* 5373 (NBG, BOL); Mamre Road, Aug., *Compton* 19866 (NBG); At the roadside between Mamre Road station and Malmesbury, Sept., *Gill* 12 (NBG); Roadside near Mamre, Aug., *Garside* 4439 (K); Sandy plains near Paardeberg, Hibbert's garden, June, *Niven* s.n. (K); Mamre, Dec., *Pole Evans* 4383 (PRE); 30 miles from Cape Town on the Darling Road, Dec., *Acocks & Hafstroin* 2111 (PRE).

WITHOUT PRECISE LOCALITY: Cape of Hood Hope anno 1831, *Jules Verreaux* s.n. (G); Prom. bon. spei, *Masson* s.n. (BM).

(32) **Leucospermum arenarium** Rycroft in Jl S. Afr. Bot. **25:** 247 (1959). Type: Between Redelinghuis and Aurora, *Rycroft* 2125 (Holotype NBG, isotypes PRE, K).

A low spreading shrub to 0,75 m in height, 1,0—1,5 m in diam., with a single main stem at base; trunk, 4,0—5,0 cm in diam., bark smooth, grey. *Flowering stems* lax, drooping, or arching onto the ground, sometimes trailing. *Leaves* secund on flowering stems; narrowly oblong-linear, 6,0—8,0 cm long, 0,7 cm wide, rather loosely spaced, usually entire, rarely with 2 or 3 teeth, slightly attenuated and twisted towards base; covered with a dense grey indumentum of fine crisped hairs. *Inflorescences* depressed globose, 5,0—7,0 cm in diam.; pedunculate to subsessile, usually solitary, occasionally in pairs; peduncle when present 1,0—4,0 cm long. *Involucral receptacle* broadly conic-depressed, 1,5 cm long, 1,5 cm broad. *Involucral bracts* ovate acuminate, 8,0—10,0 mm long, 6,0 mm broad, membranous, minutely puberulous to glabrescent; apices somewhat recurved, margins minutely ciliate; bracts reddish-carmine when fresh. *Bracteoles* oblanceolate, abruptly acuminate, 12,0 mm long, 4,0 mm broad, cartilaginous; base very densely lanate, the apex acuminate, shortly sericeous. *Perianth* 2,0—2,5 cm long, very strongly adaxially curved in bud. *Perianth tube* 7,0 mm long, cylindric, glabrous proximally becoming pilose distally. *Perianth claws* puberulous to sparsely villous, the median adaxial claw glabrous; the adaxial claws becoming strongly coiled in a sigmoid manner. *Perianth limbs* linear to narrowly lanceolate, acute, 4,0 mm long, villous. *Anthers* sessile, narrowly lanceolate

linear, acute, apical boss, pointed, yellow. *Style* 3,0—3,5 cm long, strongly incurved, tapering towards the apex, pale ivory to yellowish green. *Pollen presenter* 2,5 mm long, 0,5 mm in diam., cylindric acute, greenish towards apex; stigmatic groove terminal. *Hypogynous scales* subulate, hyaline.

Diagnostic Characters: The long, incurved, sigmoid styles (3,0—3,5 cm), on the large inflorescences (5,0—7,0 cm in diam.), the membranous involucral bracts with recurved acuminate apices and the sprawling, sub-erect growth habit, distinguish *L. arenarium* from the other species in the section *Leucospermum*.

Mrs. M. L. Thomas made the first recorded collection of *L. arenarium* in August 1958. Few subsequent collections have been made, probably on account of its inconspicuousness and the rather isolated locality in which this species grows.

Distribution, Ecology and Biology: L. arenarium is restricted to the Piketberg district where it occurs on a sandy, level plain between Klein Tafelberg and Mierberg (situated more or less midway between the towns of Aurora and Redelinghuis), and appears to be confined to the farms Langefontein and Driefontein.

The entire area is at an elevation of between 400 and 500 ft. above sea level. The plants occur as rather widely scattered individuals in deep white sandy soil, Tertiary in age. They are seen interspersed among large tufts of *Willdenowia lucaeana*, *Rhus rosmarinifolia*, *Griesebachia sp.*, *Leucadendron pubescens* and *Serruria fucifolia*, which comprise the associated vegetation. A rather low winter rainfall of 10—15″ p.a. is experienced throughout this area.

The growth habit of *L. arenarium* is very unusual in that two main branch systems can be distinguished. There is an erect system with stiff short shoots covered with loosely imbricate ascending leaves. From these branches, long looping stems arise which droop onto the ground and bear secundly arranged leaves. The inflorescences are borne at the ends of these drooping branches and are often half buried in the sandy soil.

Although all the collections of flowering material that are known were made in August, it is clear from the faded inflorescences and new buds on living plants that flowering commences in July and probably continues until October. A pale ivory-cream shade is the normal colour of the style and perianth but a form with a deep golden yellow perianth has been observed. In both forms the style becomes tinted pinkish-carmine during the fruiting stage.

Specimens Examined:

CAPE

PIKETBERG: Between Redelinghuis and Aurora, Aug., *Rycroft* 2125 (NBG, PRE, K); Between Redelinghuis and Aurora, Aug., *M. L. Thomas* s.n. (NBG, PRE, K); Six miles south of Redelinghuis on the road to Aurora, Aug., *Barker* 9724 (NBG); Between Aurora and Redelinghuis, Aug., *Williams* 839 (NBG); On the farm Driefontein 3 miles south of Redelinghuis, Aug., *Rourke* 1080 (NBG); Aurora road, 39 miles from Piketberg, Aug., *Thompson* 788 (STE, NBG).

Sect. 7. DIASTELLOIDEA Phillips

Erect, sprawling or decumbent shrubs. *Leaves* entire, very rarely with teeth at apex. *Inflorescences* small, globose, 1,0—3,0 cm in diam., in groups of 2–6. *Style* 1,0—2,5 cm long. *Pollen presenter* conic ovoid, cylindric, or clavate. Perianth colour varying with age, creamy white to pink, or yellow to orange.

Lectotype: *L. calligerum* (Salisb. ex Knight) Rourke.

Difficulty has been experienced in distinguishing certain species within this section, particularly between *L. calligerum* and *L. wittebergense*. Compton (1931) separated *L. wittebergense* from *L. calligerum* because of its smaller leaves and inflorescences and cylindric pollen presenter. It was thought to be endemic to the Witteberg. *L. calligerum* however, is a widespread and very variable species in which the pollen presenter is conic-ovoid. Thus the only significant morphological character separating the two species is the form of the pollen presenter.

Style length (as a measure of inflorescence size) correlated with the form of the pollen presenter appeared to provide a reliable method of evaluating the distinctness of the two species. The style lengths in 40 herbarium specimens with conic pollen presenters and 40 specimens with cylindric pollen presenters were measured on specimens in BOL, NBG, SAM, K and CT, and were plotted as histograms (fig 45). In specimens with a cylindric pollen presenter there is a fairly wide range in style length while the range is considerably less in material with conic-ovoid pollen presenters but there is no overlap between the two ranges. Therefore, style length when correlated with the form of the pollen presenter suggests that *L. wittebergense* is specifically distinct. Moreover it was found that *L. wittebergense* is not confined to the Witteberg but that the populations which occur along the Swartberg and adjacent mountain peaks in the Little Karoo should be referred to *L. wittebergense* and not *L. calligerum* as they are characterised by cylindric pollen presenters and significantly shorter styles.

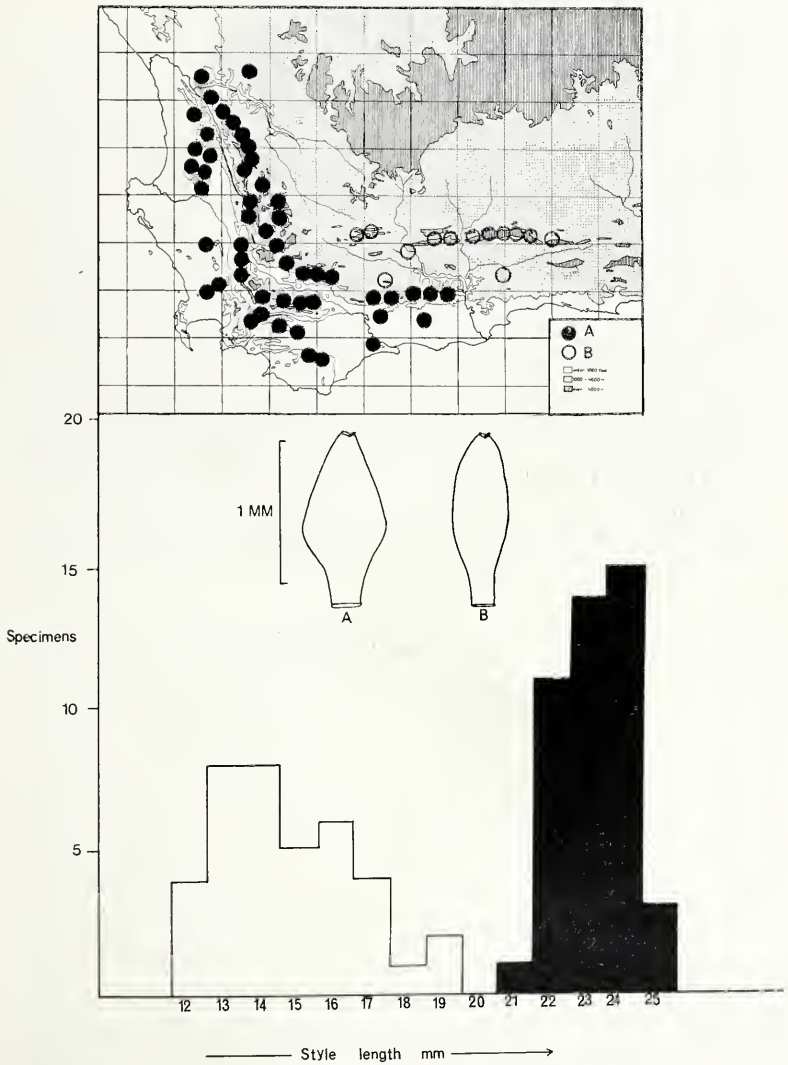


FIG. 45.

Distribution of *Leucospermum calligerum* (Salisb. ex Knight) Rourke and *L. wittebergense* Compton, showing variation in style length and differences in the form of the pollen presenters. The solid circles and pollen presenter outline (A) represent *L. calligerum* and the open circles and pollen presenter outline (B) represent *L. wittebergense*. The unshaded histogram (left) shows variation in the style length of *L. wittebergense* while the shaded histogram (right) shows variation in style length of *L. calligerum*.

(33) **Leucospermum calligerum** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **35:** 323 (1969).

Leucadendrum calligerum Salisb. ex Knight in Knight, Cult. Prot.: 60 (1809). Type: Dry Places, Twenty-four Rivers, *Niven* 41, holotype in herb. Salisbury (K), isotype in herb. J. E. Smith (LINN).

Protea pubera L., Mant. Alt.: 192 (1771),—nom. supfl. Type: As for *Leucadendron oleaefolium* Berg.

Leucadendrum puberum (L.) Salisb. ex Knight in Knight, Cult. Prot.: 61 (1809).

Leucospermum puberum (L.) R. Br. in Trans. Linn. Soc. Lond. **10:** 100 (1810); Phillips & Stapf in Fl. Cap. **5:** 634 (1912).

Leucadendron puberum (L.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Leucadendrum xeranthemifolium Salisb. ex Knight in Knight, Cult. Prot.: 60 (1809); Phillips & Stapf in Fl. Cap. **5:** 639 (1912) Type: Elevated places at Jackall Flyberg, *Niven* s.n., not traced. (i.e. Jackalsvlei mts., Clanwilliam.)

Leucadendrum gnaphaliifolium Salisb. ex Knight in Knight, Cult. Prot.: 60 (1809); Phillips & Stapf in Fl. Cap. **5:** 638 (1912). Type: "Low dry situations" without collector or locality, not traced.

An erect to suberect shrub to 2,0 m in height, 3,0 m in diam., the lowermost branches often sprawling; with a single main stem at base. *Flowering stems* erect 3,0—5,0 mm in diam., covered with a dense indumentum of fine crisped hairs interspersed with straight patent trichomes. *Leaves* sessile, lanceolate to elliptic, acute, 1,2—3,6 cm long, 4,0—8,0 mm wide, apex entire very rarely 2 or 3 dentate; loosely ascending imbricate; dull grey to olivaceous, occasionally canescent, permantly villous. *Inflorescences* globose, 2,0—3,5 cm in diam., rarely solitary, usually 2—6 nate; subsessile to pedunculate, peduncle to 3,0 cm long. *Involucral receptacle* shortly conic-depressed, 3,0 mm long, 3,0 mm wide, *Involucral bracts* lanceolate, acute to acuminate, 5,0—7,0 mm long, 2,0—3,0 mm wide, cartilaginous, imbricate; apices recurved, crinite and cinereous; outer surface tomentose. *Bracteoles* oblanceolate acuminate, 5,0—7,0 mm long, cartilaginous, apex crinite, outer surface densely lanate. *Perianth* 1,5—1,7 cm long, straight in bud, pale cream, flushed with dull carmine. *Perianth tube* 5,0 mm long, very slightly quadrangular, glabrous. *Perianth claws* villous, equally recurved subterminally on opening. *Perianth limbs* lanceolate acute, 1,5 mm long, beset with long, straight, silky trichomes. *Style* 2,1—2,5 cm long, tapering subterminally, slightly adaxially arcuate on opening, straightening at maturity; yellow at first becoming dull carmine. *Pollen presenter* conic-ovoid, 1,0 mm long, yellow, stigmatic groove terminal. *Hypogynous scales* 2,0 mm long, subulate.

Diagnostic Characters: L. calligerum is distinguished from related taxa by its erect growth habit, permanently pubescent, entire leaves; the style, 2,1—2,5 cm long, and the conic ovoid pollen presenter.

Material of *L. calligerum* reached Europe at a comparatively early stage for there are specimens in Burman's herbarium (G) collected by Oldenland, but it was not until 1771 that the species was described. Unfortunately, when Linnaeus published the original description in the *Mantissa Altera*, he cited *Leucadendron oleaefolium* Berg. as a synonym, thus rendering *Protea pubera* L. a superfluous name. Despite the recent relaxation of Article 63 of the International Code it is impossible to uphold Linnaeus' familiar epithet "pubera" since he neither excluded explicitly nor by implication, the type of the name he ought to have adopted (Stafleu, 1970: 41–42). Of the three binomials, *Leucadendrum calligerum*, *L. xeranthemifolium* and *L. gnaphaliifolium* published simultaneously by Knight, only the type of *L. calligerum* has been traced, although it is quite evident from the descriptions of *L. gnaphaliifolium* and *L. xeranthemifolium* that all three are conspecific.

Distribution and Ecology: One of the most widely dispersed species in the genus, *L. calligerum* occurs throughout the South Western Cape from Lokenberg and the Gifberg in the north as far as Riversdale and Albertinia in the south east.

L. calligerum favours hot, dry, very well drained situations receiving a rather low winter rainfall of 10—12″ p.a. Particularly noteworthy is the fact that this species never occurs where the mean annual rainfall exceeds 30″. Apart from these conditions it appears to have no special ecological requirements. The habitats may vary from level sandy flats near the coast at elevations of about 500 ft. to steep rocky mountain slopes on inland ranges at 4 000 ft. Although most populations are found on Table Mountain Sandstone, they grow equally well on weathered Cape Granite and Malmesbury Shale conglomerate at a few localities. Flowering takes place from July to January. On opening, the perianths and styles are creamy yellow but become flushed with dull carmine as they age. The inflorescences are generally sweetly scented.

Specimens Examined:

CAPE

CALVINIA: Lokenberg, 21 miles S. of Niewoudtville, Oct., *Story* 4354 (GRA); Lokenberg, Sept., *Leistner* 335 (PRE, NBG, K); Lokenberg, arid fynbos, Aug., *Acocks* 17096 (PRE).

VAN RHYNSDORP: Heerenloggementsberg, Sept., *H. C. Taylor* 3924 (STE, PRE, NBG); Gifberg, Sept., *Phillips* 7386, 7416 (BOL); Gifberg, Oct., *Esterhuysen* 21986 (BOL, PRE); Gifberg, Sept., *Compton* 20781 (NBG); Tigerberg above Kobee Pass, Aug., *Williams* 1018 (NBG); Klaver, Nov., *Austin Roberts* s.n. sub PRE 25656 (PRE); Sandkraal, along western edge of Gifberg, July, *van Breda* 1612 (PRE); Gifberg, halfway up pass, Aug., *Rourke* 1063 (NBG).

CLANWILLIAM: Oliphants River valley near Modderfontein, Sept., *Stephens* 6936 (BOL, K); One mile S.E. of Keerom, Nov., *Pillans* 8753 (BOL, NBG); Western end of Elands Kloof, *Lewis* 3674 (SAM); Klein Kliphuis, Pakhuis, Sept., *Hardy* 810 (PRE, BM, K); Foothills of Cedarberg near Algeria, Oct., *Galpin* 10522 (PRE, K); Berg fly, *Niven* 42 (PH, BM, & in herb. Smith, LINN); Niewoudts Pass, Dec., *Salter* 5061 (K); Pakhuis Pass, Oct., *Acocks* 15042 (PRE, K); Biedouw at Pakhuis, 10/1/1831, *Drège* 476c (P); Bergvalei, at Zwartbastkraal, 10/7/1830, *Drège* 476 bb (P); Bergvlei, at Langvlei, 18/11/1828, *Drège* 476 b (P); At Uitkoms above Graafwater, Sept., *Acocks* 3019 (S); Hill behind homestead at Krommerivier, Cedarberg, Sept., *Acocks* 3137 (S); Langvlei, July, *Williams* 818 (NBG); 4 miles north of Paleisheuvel, Sept., *H. Hall* 1007 (NBG); Biedouw, upper plateau, *Middlemost* 1893 (NBG); 6 miles south of Wupperthal, Aug., *Rycroft* 2256 (NBG); Pilaarsberg, north of Pakhuis Pass, Sept., *Kerfoot* 5914 (NBG); Matjiesrivier, Cedarberg, Oct., *Wagener* 265 (NBG); Elands Kloof, Sept., *Johnson* 527 (NBG); Kromme River, Sept., *Compton* 5032 (NBG); Lambertshoekberg, Aug., *Compton* 5498 (BOL, NBG); Modderfontein, Clanwilliam, Sept., *Compton* 4286 (BOL, NBG); Krakadouw Heights, Oct., *Pocock* s.n. (BOL); Biedouw mts., near Pakhuis Pass, Nov., *Thode* A2135 (NH, K); Ezelbank, Oct., *Thode* A2065 (NH); Mountain Pass to Algeria, Sept., *Story* 2959 (GRA); Heuning Vlei, Oct., *Pocock* 571 (STE); Kardouw Pass, Oct., *Hubbard* 252 (STE); Blauwberg, Aug., *Schlechter* 8463 (BOL, Z, PRE, S, PH); Alexandershoek, Sept., *Schlechter* 5128 (STE, GRA, BOL, SAM, PRE, BR, S, K, BM, Z).

PIKETBERG: Kapiteins Kloof, Sept., *Pillans* 7705 (BOL, NBG); Summit and west edge of Sandberg, Piketberg, Oct., *Pillans* 8578 (BOL); Dry places Twenty-four rivers district, *Niven* 41 (K) and in herb. Smith (LINN); Bosch Kloof, Sept., *Bond* 539 (NBG); Between Redelinghuis and Aurora, Aug., *Rycroft* 2124 (NBG).

CERES: Michells Pass, Jan., *Barnard* s.n. sub SAM 44124 (SAM); Matroosberg near Laaken Vlei, Nov., *Phillips* 2129 (SAM); Visgat between the Schurfteberg and Great Winterhoek, Oct., *Stokoe* s.n. sub. SAM 63180 (SAM); Bokkeriver farms, Nov., *Horrocks* 137 (NBG); Zoo Ridge on Grootrivier rd., from Koue Bokkeveld to Cedarberg, Dec., *H. C. Taylor* 6127 (PRE); Katbakkies, Swartruggens range, Oct., *Rourke* 955 (NBG).

TULBAGH: Tulbagh Kloof, Oct., *Andreae* 660 (STE); Saron, Jan., *Thode* 4751 (STE); Tulbagh Kloof, Nov., *Zeyher* 1463 (SAM, PRE, STE, K, FI, NH, S); In lapidosis clivis, Nieuwekloof, Oct., *MacOwan* no. 779 in Herb. Norm. Austro. Afr. (BOL, SAM, Z, BM, K, G); Mountains around Tulbagh Kloof, Nov., *Bolus* 5233 (NH, BOL, BM, Z, K); Nieuwekloof, 18/10/1828, *Drège* 476a (P); On the Witzenberg near Tulbagh, 17th April, 1811, *Burchell* 8726 (K).

WORCESTER: Bosjeveld mts., April, *Andreae* 337 (STE); Audensberg, Oct., *Marloth* 2437 (STE); Keeromsberg, Oct., *H. C. Taylor* 6453 (STE, PRE); Bonteberg, Eikenbosch Hoek, Nov., *Esterhuysen* 3704 (BOL); Keeromsberg, Nov., *Esterhuysen* 9240 (BOL); Bokkeriver, Sept., *Levyns* 942 (CT); Goudini Rd., Oct., *Levyns* 2826 (CT); Slanghoek, Oct., *Rycroft* 2355 (NBG); Bonteberg, Nov., *Compton* 9930 (NBG); Lower N. slopes of Jonaskop, Sept., *Rycroft* 2873 (NBG); Wildepaardeberg mts., top of Baviaanskloof, *Stokoe* 6567 (PRE); Vaalkloof, north slopes of Bonteberg, Aug., *Marloth* 9095 (PRE, NBG).

PAARL: Elands Kloof mts., north of Wellington, Oct., *Stokoe* s.n. sub. SAM 70038 (SAM); Olyvenbosch farm, near Wellington, Nov., *Salter* 1781 (BM, K).

BELLVILLE: Hercules Pillar, Oct., *Compton* 20152 (NBG); Joostenberg, Oct., *Lewis* 5904 (NBG); Between Volmoed and Hercules Pillar, Oct., *Rourke* 940 (NBG); Phisantekraal, Oct., *Rourke* 937 (NBG).

MALMESBURY: Kleinhoop, 2 miles S.W. of Malmesbury, Oct., *Rourke* 929 (NBG).

CALEDON: Zwartberg, Oct., *Schlechter* 5558 (PRE, STE, SAM, BR, Z, S, G, K, BM); Ezeljacht, Dec., *van Breda* 1657 (STE, K); Caledon, Jan. 1894, *Otto Kuntze* s.n. (NY, K); Mountains at Houwhoek, Oct., *Zeyher* 1463 (GRA); Rock situations of Houwhoek, *Bowie* s.n. (BM); Zwartberg, Nov., *Pappe* s.n. sub SAM 19603 (SAM); Caledon, July, *Garside* 201 (K); Mountains of Baviaanskloof near Genadendal, 27th Feb. 1815, *Burchell* 7822 (K); On Donkerhoek mountain, 9th March 1815 *Burchell* 7939 (K); Driefontein, east end of Caledon mts., June, *Williams* 17 (NBG); Ezeljacht, July, *Walters* 3 (NBG); Between Caledon & Villiersdorp, Sept., *Rycroft* 1725 (NBG).

BREDASDORP: Potteberg, Sept., *Esterhuysen* 23190 (BOL); Entrance to Boschkloof, Potteberg, Oct., *Pillans* 9438 (BOL); Potteberg, Dec., *Codd* 9946 (K); 2 miles S.E. of Potteberg farm, Sept., *Rourke* 598 (NBG).

ROBERTSON: Boesmans Kloof Pass at McGregor, Oct., *Esterhuysen* 59091 (BOL); Boesmanskloof Pass, *Esterhuysen* 7649 (BOL); Sandberg, Oct., *Pearson* 3430 (SAM).

MONTAGU: Patatsfontein, Waboomsberg, July, *Rycroft* 2084 (NBG); Montagu Baths, Dec., *Bolus* sub. *Gutlirie* 2768 (NBG); Top of mountain near Montagu Baths, Oct., *Michell* 153 (PRE).

SWELLENDAM: Bontebok Park, Sept., *Liebenberg* 4425 (STE); Zuurbrak peak, Oct., *Barnard* s.n. sub SAM 28972 (SAM); Tradouw Pass, Oct., *Adamson* s.n. sub. SAM 39005 (SAM); Bèrgsig farm near Barrydale, Sept., *Williams* 1062 (NBG); Lifford farm near Barrydale, Sept., *Williams* 1045 (NBG); Bontebok Park, Aug., *Grobler* 487 (PRE).

RIVERSDALE: Garcia's Pass, Muiskraal, Oct., *Bolus* 11364 (BOL, PRE, NH); Crystal Kloof, Oct., *Williams* 542 (BOL); Garcia's Pass, Aug., *Morris* 248 (BOL, NBG); Waterfall, on the Muiskraal/Gouritsriver road, July, *Levyns* 11281 (CT); Tygerfontein, near Albertinia, May, *Muir* s.n. sub SAM 2714 (SAM); Garcia's Pass, Sept., *Phillips* 516 (SAM, K); Albertinia commonage, Oct., *Muir* 607 (Z); Muiskraal, hills on N. slopes of Langeberg, Jan., *Rourke* 247 (NBG); Brandrivier, Barrydale to Muiskraal rd., Sept., *Williams* 1051 (NBG); Betweeen Muiskraal and Cloete's Pass, April, *Horrocks* 4 (NBG); Albertinia Plateau, 10 miles east of Riversdale, Sept., *Rourke* 912 (NBG).

WITHOUT PRECISE LOCALITY: Cape of Good Hope, *Masson* s.n. (BM); Without collector, cat. no. 4101 in herb. Jussieu (P—JU); C.B.S., *Oldenland* in herb. Burman (G); C.B.S. *Wanmann* in herb. Bergius (SBT); C.B.S., *Thunberg* s.n. sheets 2964 & 2965 in herb. Thunberg (UPS).

(34) **Leucospermum wittebergense** Compton in Trans. R. Soc. S. Afr. **19**: 280 (1931). Types: Top of Witteberg, *Compton* 2822, lectotype (BOL); Witteberg summit, *Compton* 3563, syntype (K).

An erect, much branched shrub 0,5—1,5 m in height. *Flowering stems* erect, terete, 3,0 mm in diam., often covered with prominent leaf scars. *Leaves* elliptic-lanceolate, entire, 1,5—2,5 cm long 3,5—6,0 mm wide; covered with a short, dense indumentum of fine crisped hairs, greyish to silvery; ascending imbricate, *Inflorescences* globose, sessile, 2,0 cm in diam., usually solitary. *Involucral receptacle* obconic truncate, 4,0 mm wide. *Involucral bracts* broadly lanceolate, acute-acuminate, 4,0 mm long, 2,0 mm wide; densely villous, cartilaginous, tightly imbricate. *Bracteoles* oblanceolate-cuspidate, 6,0—7,0 mm long, 1,0—2,0 mm wide, densely lanate; carmine coloured when fresh. *Perianth* 1,5 cm long, straight in bud, pale cream becoming pinkish. *Perianth tube* 3,0 mm long, puberulous distally, glabrous proximally. *Perianth claws* 1,0 cm long, thickly villous; pinkish carmine, inner surface creamy yellow. *Perianth limbs* elliptic 1,5 mm long, thickly villous, scarcely differentiated from claws, recurved on opening. *Style* 1,2—1,9 cm long, filiform, straight to very slightly arcuate, pink to carmine when fresh. *Pollen presenter* clavate to cylindric-obtuse, 1,0 mm long, yellow when fresh. *Hypogynous scales* filiform, 0,5—0,7 mm long, hyaline.

Diagnostic Characters: L. wittebergense is distinguished by the short style, 12—19 mm long, the clavate to cylindric-obtuse pollen presenter and the crowded ascending imbricate leaves beset with a short, dense, greyish-silvery indumentum.

Drège made the first recorded collection of *L. wittebergense* in July 1829, on the Swartberg. Nearly all subsequent gatherings were made after the publication of the Proteaceae in the *Flora Capensis* where it was confused with *L. puberum* R. Br.

Two syntypes were cited by Compton. Of these, the specimen at the Bolus herbarium labelled "type" in Compton's handwriting (*Compton* 2822) has been chosen as the lectotype.

Distribution and Ecology: L. wittebergense occurs from the Witteberg, eastwards along the Swartberg to a few miles east of Meirings Poort. It has also been recorded on Touwsberg and the Warmwaterberg in the Little Karroo and at Klein Moeras River on the north slopes of the Outeniqua range near Oudtshoorn.

This species is found on arid rocky slopes of either Table Mountain Sandstone or Witteberg Quartzite, between 2 500 and 6 000 ft., in north or south facing situations. Arid Fynbos constitutes the associated vegetation. On the Swartberg, specimens up to 1,5 m in height are not unusual while plants on the Witteberg are more stunted and seldom exceed 0,5 m. The differences in the vigour of these plants appears to be correlated with mean annual rainfall which is about 10″ p.a. on the Witteberg and up to 20″ p.a. on the Swartberg. Flowering takes place from August to January.

Specimens Examined:

CAPE

LAINGSBURG: Top of the Witteberg, Nov., *Compton* 2822 (BOL); Witteberg, Oct., *Leighton* 237 (BOL); Witteberg summit, Oct., *Compton* 3563 (K); Witteberg, Oct., *Compton* 15189 (NBG); Witteberg, Whitehill, Oct., *Compton* 7951 & 13942 (NBG).

SWELLENDAM: Warmwaterberg, Little Karroo, on the top, July, *Levyns* 6181 (CT).

LADISMITH: Touwsberg, June, *Esterhuysen* 25954 (BOL); Seven Weeks Poort, Sept., *Levyns* 2444 (CT); Towerkop, Sept., *Esterhuysen* 13954 (BOL); Touwsberg, on the top, July, *Levyns* 6110 (CT); Seven Weeks Poort, Sept., *Phillips* 1507 (SAM); Seven Weeks Poort Berg, Dec., *Barnard* s.n. (SAM 46291); Seven Weeks Poort mountains below 2nd peak, Dec., *Andreae* 1261 (PRE); Seven Weeks Poort mountains, north slopes, Dec., *Stokoe* 1818 (PRE); *Primos* 83 (PRE); Western slopes of Seven Weeks Poort, Dec., *Stokoe* 1917 (STE).

CALITZDORP: Sandberg, west of Calitzdorp, June, *Wurtts* 1364 (NBG).

OUDTSHOORN/PRINCE ALBERT: Swartberg Pass, Sept., *Sidey* 1901 (PRE, S); Swartberg Pass, June, *Deas* 12 (GRA); In saxosis in summo monte Zwartberg Pass, Dec., *Bolus* 11628 (BOL, PRE, NH, BR); Upper peaks of the Swartberg, May, *Pocock* S248 (BOL, STE); Cango East, Oct., *Deas* s.n. (SAM 5142); Swartberg Pass, Nov., *Barnard* s.n. (SAM 48189); Swartberg mountains, Oct., *Stokoe* s.n. (SAM 62124); Higher slopes of Spitzkop, 5 miles east of Meiring's Poort, Feb., *Thorne* s.n. (SAM 50195); Swartberg, 2 500—3 000 ft., 27/7/1829, *Drège* 476h (P); Swartberg, Nov., *E. Wall* s.n. (S); Swartberg Pass, Jan., *Compton* 10427 (NBG); Swartberg Pass, on the road to the east at top of pass, Nov., *Williams* 963 (NBG); Quartzite mountains near Prince Albert, Oct. 1898, *Schimper* s.n. (Z); North side of Outeniqua mountains near Moeras River, Dec., *Esterhuysen* 19475 (BOL); Klein Moeras River Spruiten, Dec., *Barker* 7710 (NBG).

GEORGE: Paarde Poort, George dist., Aug., *Thorne* s.n. (SAM 51644).

(35) **Leucospermum royenifolium** (Salisb. ex Knight) Stapf in Fl. Cap. **5:** 635 (1912).

Leucadendrum royenaefolium Salisb. ex Knight in Knight, Cult. Prot.: 59 (1809). Type: Duivelskop Pass, rocky elevated places, decumbent, alpine, *Niven* 43, holotype in herb. Salisbury (K), isotypes in herb. J. E. Smith (LINN), (PH).

Leucospermum puberum (L.) R. Br. var. *dubium* Meisn. in DC., Prodr. **14:** 259 (1856). Type: *Drège* "f" in herb. DC. (not found). Klip River, Longkloof, 13/11/1831, *Drège* 476 f (P)—presumed isotype.

A sprawling, semi-erect to prostrate shrub, developing into a dense mat 1,0—3,0 m in diam., 0,5 m in height. *Basal branches* stout and woody, spreading horizontally, 3,0—6,0 cm in diam., covered with a tough layer of bark 3,0—5,0 mm thick. *Flowering stems* semi-erect to trailing, 2,0—3,0 mm in diam., puberulous at first, soon glabrous. *Leaves* elliptic, attenuate at base, apex acute, entire, very rarely bifid or trifid; leaves 1,5—2,2 cm long, 0,4—0,6 cm wide, loosely patent, usually glabrous, or puberulous at first, soon becoming glabrous. *Inflorescences* globose, 1,0—2,0 cm in diam., sessile to pedunculate, peduncle 1,0 cm long; solitary, but usually with 3—5 inflorescences per shoot, on vigorous young shoots, multiple inflorescences (20—30), develop in uppermost leaf axils. *Involucral receptacle* broadly conic-depressed, 5,0 mm long, 4,0 mm wide. *Involucral bracts* ovate-acute, 5,0 mm long, 3,0 mm wide, cartilaginous, softly tomentose; apices of the uppermost series slightly acuminate and recurved. *Perianth* 1,0—1,5 cm long, straight in bud, slightly laterally compressed, shortly tomentose, the perianth claws becoming equally deflexed subterminally; cream to greenish at anthesis becoming pale carmine with age. *Perianth tube* 4,0 mm long, glabrous and narrowed proximally, puberulous distally. *Perianth limbs* lanceolate acute, 1,5 mm long, the outer surface beset with stiff erect trichomes. *Style* straight, 1,3—1,6 cm long, tapering towards the apex; pale greenish-cream at anthesis becoming pinkish carmine with age. *Pollen presenter* cylindric obtuse, 1,0 mm long, stigmatic groove terminal. *Hypogynous scales* linear, 2,0 mm long, hyaline.

Diagnostic Characters: Among the species of the Sect. *Diastelloidea* with styles 1,2—1,9 cm long and clavate to cylindric-obtuse pollen presenters, *L. royenifolium* is distinguished by its procumbent growth habit and the glabrous to glabrescent patent leaves. Although nearly always glabrous, the bright green leaves are very occasionally sparsely hirsute but soon become glabrous.

Niven's collection from Duivel's Kop on the north side of the Outeniqua range appears to be the first on record and was probably made between 1799 and 1803. Although most early 19th century horticultural textbooks make no mention of *L. royenifolium*, Knight (1809: 59) notes that it is "hardy", which seems to indicate he had successfully cultivated it in Hibbert's collection.

Distribution and Ecology: This species is found throughout the length of the Longkloof on the northern foothills of the Outeniqua range as far as Misgund; from the Meiring's Poort area on the Swartberg it extends eastwards to the Kamanassie, Kouga and Baviaanskloof mountains reaching Scholtzberg at the most easterly point of its range.

In comparison with most other members of the genus, *L. royenifolium* endures fairly rigorous climatic conditions, tolerating a dry environment which experiences great heat in summer and frost in winter. The low winter rainfall of 10—15″ p.a. is distributed more or less evenly throughout the year with a slight winter maximum. Most populations occur between 2 000 and 4 000 ft., always on Table Mountain Sandstone or Witteberg Quartzite, in hot, exposed, north facing positions. In most places it occurs in Arid Fynbos but occasionally even grows on the fringes of Rhenosterbosveld.

The growth habit of the mature plant is sprawling and untidy and it seldom attains a height of more than 0,5 m. A layer of tough corky bark on the horizontally spreading basal branches gives the adult plant a certain measure of protection against fire. New shoots are able to regenerate from these main branches after the remainder of the plant has been burnt off.

Under optimum conditions the young flowering shoots produce multiple inflorescences. Between 20 and 40 inflorescences on a single flowering shoot have been counted. On opening, the perianth and styles are pale cream to ivory in colour, later changing to deep pink. The sweetly scented inflorescences are produced between July and December.

Specimens Examined:

CAPE

GEORGE: Duivel's Kop, rocky elevated places, *Niven* 43 (K, LINN, PH); Between Cape Town and Georgetown, 1859–62, *W. Moyle-Rogers* s.n. (BM); Duivel's Kop, Oct., *Fourcade* 1615 (BOL, K); Longkloof, in district of George, Nov., 1847, *Alexander Prior* s.n. (K); Gans-kraal, Longkloof, Oct., *Rourke* 613 (NBG); Molen River, Longkloof, Sept., *Rourke* 907 (NBG).

UNIONDALE: On a rocky hill near Haarlem, 14th March, 1814, *Burchell* 4993 (K); Haarlem, Sept., *Schonland* 3115 (STE); South side of the mountain between Uniondale and Avontuur, Dec., *Schonland* 3352 (GRA, PRE, K); Uniondale, Nov., *Paterson* 3026 (GRA, Z); Haarlem, July, *Markotter* s.n. (STE 20211); Hoopsberg, Nov., *Esterhuysen* 6605 (BOL); Kouga mountains, peak east of Smutsberg, Nov., *Esterhuysen* 6993 (BOL); Kamanassie mountains at Laudina, Nov., *Esterhuysen* 16462 (BOL); Mannetjiesberg, south slopes, Nov., *Esterhuysen* 6603 (BOL, K); Potjiesriverhoogte, July, *Rourke* 12 (BOL, NBG); Kamanassie mts., Jan., *Stokoe* s.n. (SAM 54380); Klipriver in the Longkloof, 2 500—3 500 ft., 13/11/1831, *Drège* 476f (P, K); Kamanassie mts., April, *Rycroft* 1901 (NBG); Avontuur, Longkloof, Oct., *Bayliss* 3690 (NBG, Z); Slypsteenberg, south slopes, Nov., *Esterhuysen* 6348 (BOL, PRE); Avontuur, Nov., *Marloth* 10949 (PRE); Mountains near Uniondale, *Bolus* 2453 (PRE); Longkloof, 30 miles from Uniondale, Sept., *Middlemost* 2105 (NBG); Lower slopes of Hoopsberg, Dec., *Williams* 1376 (NBG); Half a mile beyond the farm Bo Kouga, Sept., *Rourke* 892 (NBG); Mannetjiesberg, south slopes, Sept., *Rourke* 861 (NBG).

JOUBERTINA: Ouplaas, in the Kouga mountains, June, *van Breda* 1178 (PRE, K); Between Misgund and Ongelegen, May, *Rycroft* 2281 (NBG); One mile west of Misgund Oos, Sept., *Rourke* 875 (NBG).

WILLOWMORE: Kierfonteinberg, Vondeling, between Klaarstroom & Willowmore, Oct., *Thorne* s.n. (SAM 53368); Swartberg, Dec., *Stokoe* s.n. (SAM 56308); Scholtzberg, Baviaanskloof range, Sept., *Urton* 432 (GRA).

WITHOUT PRECISE LOCALITY: Prom. bon. spei, *J. Roxburgh* s.n. (G).



FIG. 46.
Distribution of *Leucospermum royenifolium* (Salisb. ex Knight) Stapf.

(36) **Leucospermum heterophyllum** (Thunb.) Rourke in Jl S. Afr. Bot. **33:** 266 (1967).

Protea heterophylla Thunb., Diss. Prot.: 24 (1781). Lectotype: Cap. b. spei, *Thunberg* s.n., sheet no. 2921 in herb. Thunberg (UPS).

Leucadendron heterophyllum (Thunb.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Leucospermum patulum R. Br. in Trans. Linn. Soc. Lond. **10:** 100 (1810). Type: Africa australis, Prom. bon. spei, *Masson* s.n. (BM).

Protea patens Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 567 (1816)—nom. supfl., et non *P. patens* R. Br. (1810).

Leucospermum lemmerzianum Schltr. in Bot. Jahrb. **27:** 111 (1900). Type: Hills near Elim, *Schlechter* 9663 (Holotype B, isotypes K, Z, G, S, BR, BM, BOL, PRE).

A prostrate shrub forming large, flat, dense mats, 1,0—6,0 m in diam., 10,0—15,0 cm in height. *Basal branches* stout and woody 5,0 cm in diam., arising from a large woody rootstock 5,0—10,0 cm in diam., and then spreading horizontally along the ground. *Flowering stems* arising at perimeter of mat; slender, terete, 1,0—2,0 mm in diam., trailing along the ground, often bearing short lateral flowering branchlets. *Leaves* oblanceolate to linear-spathulate, 20,0—30,0 mm long, 3,0—6,0 cm wide; apex usually truncate and trifid, occasionally entire and acute; glabrescent to glabrous, usually sparsely covered with short crisped hairs at first, soon becoming glabrous; sessile, arising from stems in a subsecund to secund manner, slightly twisted at base. *Inflorescence* globose, 2,0—3,0 cm in diam.; pedunculate, peduncle 1,0—2,0 cm long. *Involucral receptacle* depressed-ovoid, 2,0—3,0 mm in diam. *Involucral bracts* ovate acute, 3,0—4,0 mm long, 1,0—2,0 mm wide, imbricate, cartilaginous, shortly tomentose, the apices somewhat recurved and minutely crinite. *Bracteoles* broadly ovate acute 3,0 mm long, 2,0 mm wide, lanate. *Perianth* 15,0 mm long. *Perianth tube* 4,0 mm long, glabrous but slightly villous distally; narrowing proximally. *Perianth claws* pale yellow-green, villous; becoming equally recurved in the subterminal region. *Perianth limbs* narrowly lanceolate acute, 1,0 mm long, tomentose, dark brown when fresh. *Anthers* sessile, narrowly lanceolate, 0,75 mm long, apical boss pointed, yellow. *Style* 18,0—21,0 mm long, straight, tapering in the upper third; pale yellow becoming dull carmine with age. *Pollen presenter* conic-ovoid, yellow; stigmatic groove terminal. *Hypogynous scales* linear, filiform, hyaline, 2,0 mm long.

Diagnostic Characters: The glabrous to glabrescent leaves, oblanceolate-cuneate and slightly twisted at the base, usually tridentate at the apex and the prostrate growth habit, distinguish *L. heterophyllum* from the other species in the section.

Despite the very restricted range of this species, material was collected fairly early in the 18th century, for there is a very complete specimen in N. L. Burman's herbarium in Geneva which was probably collected by Oldenland or Auge. At Uppsala and the British Museum there are specimens of *L. heterophyllum* that are attributed to Thunberg and Masson respectively. When and where they collected this material remains a mystery for the route which they followed when travelling together in 1773–1774 bypasses the Elim–Bredasdorp area by 20 miles. Indeed, on no occasion did either Thunberg or Masson ever pass through the Bredasdorp district, according to published records. Masson's specimen is the type of *L. patulum* R. Br. and Thunberg's is the type of *P. heterophylla* Thunb. Three sheets in Thunberg's herbarium are labelled *Protea heterophylla*. One of these (no. 2921) is labelled *Protea heterophylla* α, the remaining two (2922, 2923) are both labelled *P. heterophylla* β. The material on these latter two sheets has entire leaves. The only specimen which can possibly be the type is mounted on sheet 2921, since it matches Thunberg's description perfectly in that it has glabrous tridentate leaves.

Distribution and Ecology: This very localised species is confined to a few square miles in the Bredasdorp district, within an area bounded by Elim in the west, Bredasdorp in the north-east and Soetendals Vlei in the south.

A notable feature of the ecology of *L. heterophyllum* is that it tends to be found mainly on a curious sandstone and quartzite conglomerate of the Table Mountain series which outcrops at several places in the Bredasdorp district (Spies et al. 1963: 11–12). In a few places it also grows on soils derived from fine grained graywacke, also a conglomerate but belonging to the Malmesbury series. Very occasionally plants are found on sandy soils belonging to Tertiary deposits, but this is exceptional. The associated vegetation is low and sparse consisting mainly of Ericaceae, Thymelaeaceae and Restionaceae. A winter rainfall of 15—20″ p.a. is experienced.

When mature, *L. heterophyllum* becomes a dense, low, spreading mat up to 6 m in diam., never more than 20 cm in height. Stout main branches 4—10 cm in diam. radiate from a single main stem and spread horizontally along the soil surface. This species has a certain degree of fire resistance. Most of the more slender peripheral branches are destroyed during a bush fire but new shoots frequently sprout from the stout basal branches which are covered with a fairly thick layer of bark.

Flowering takes place from August to January with a peak during September and October. The inflorescences are pale yellow to green, fading to carmine and are produced in great profusion at the height of the flowering season.

Specimens Examined:

CAPE

BREDASDORP: In collibus prope Elim, Dec., *Schlechter* 9663 (B, Z, G, S, BR, BM, K, BOL, PRE); Bredasdorp, Dec., *Galpin* 11281 (PRE, K); 2 miles south of Bredasdorp, Sept., *Salter* 4809 (BOL, SAM, PRE, BM, K); In collibus prope Elim, Dec., *Bolus* 8585 (BOL, NBG, NH, K); Near Bredasdorp, Oct., *L. Guthrie* 182 (BOL); On the Nachtwacht—Martha's gat borderline, Nov., *Smith* 4910 (PRE); Bredasdorp, July, *van Niekerk* 420 (BOL); The Poort, Bredasdorp, Sept., *Leighton* 21112 (BOL, K); Bredasdorp, slopes behind the town, Sept., *Levyns* 2146 (CT); Between Bredasdorp and Elim, Sept., *Levyns* 4530 (CT); 5 miles S.W. of Bredasdorp, Dec., *Codd* 9955 (PRE); In collibus prope Elim, Oct., *Bolus* 7873 (PRE, K); Springfield estate, Sept., *Stokoe* s.n. (SAM 62125); Bredasdorp, Oct., *Breach* s.n. (SAM 51339); Flats between Bredasdorp and Elim, Dec., *Acocks & Hafstrom* 2109 (PRE, S); 10 miles S.W. of Bredasdorp, Sept., *Sidey* 1819 (PRE, S); On the farm Rietfontein, Bredasdorp, Oct., *van Breda* 2052 (PRE); Sandhoogte, below dunes, Sept., *C. A. Smith* 3005 (PRE); Flats at Soetendals Vlei, Dec. 1838, *Krauss* 1064 (M); Mierekraal at Elim, Dec., *E. Wall* s.n. (S); The Poort, Bredasdorp, Sept., *Acocks* 1777 (S); 1 mile from Bredasdorp on the Agulhas road, Sept., *Richmond* 14 (NBG); Near Elim, Aug., *Barker* 5574 (NBG); Between Bredasdorp and Elim, Oct., *Compton* 22132 (NBG); 9 miles S.W. of Bredasdorp, Sept., *Rycroft* 2520 (NBG); Springfield, Jan., *Rycroft* 1825 (NBG); Between Bredasdorp and Elim, Sept., *Rourke* 275 (NBG); Hills 1 mile north of the Soetanysberg, Nov., *Rourke* 1016 (NBG); Voelvlei, a few miles east of Elim, Oct., *Rourke* 945 (NBG); At the farm Jacobsdam north of the Soetanysberg, Oct., *Rourke* 1125 (NBG); Near Soetendalsvlei, west side, Dec., *Rourke* 1169 (NBG); Springfontein, between homestead and saltpan, Dec., *Rourke* 1171 (NBG); Between Rietfontein and Klipfontein on Rd. to Skipskop, June, *Rourke* 1247 (NBG).

WITHOUT PRECISE LOCALITY: Prom. bon. spei, *Mund* s.n. (B); Prom. bon. spei, *Masson* s.n. (BM); Prom. bon. spei, *Nelson* s.n. (BM); Cap. b. spei, *Thunberg* s.n. in herb. Bergius (SBT); Cap. b. spei, *Thunberg* s.n., no. 2921 (UPS); Cap. b. spei, without collector in herb. Burmann (G); Without collector or locality in herb. Lamarck (P—LA).

(37) **Leucospermum truncatulum** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **33:** 266 (1967).

Leucadendrum truncatulum Salisb. ex Knight in Knight, Cult. Prot.: 61 (1809). Type: "Klein Hout Hoek, *Niven* 200", holotype in herb. Salisbury (K).

Leucospermum buxifolium R. Br. in Trans. Linn. Soc. Lond. **10:** 100 (1810); Phillips & Stapf in Fl. Cap. **5:** 633 (1912). Type: Africa australis, *Masson* s.n. (BM).

Protea buxifolia (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 566 (1816).

Leucadendron buxifolium (R. Br.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

Protea villosa Willd. in Spreng., Syst. Veg. **1:** 464 (1825)—nom. nud.

Leucospermum buxifolium R. Br. forma *epacridea* Gandoger in Bull. Soc. bot. Fr. **48:** 94 (1901). Type: Mountains at Babylonstower near Ecksteen's, Aug., *Zeyher* 3685 holotype in herb. Gandoger (LY).

Leucospermum epacrideum (Gandoger) Gandoger and Schinz in Bull. Soc. bot. Fr. **60:** 53 (1913). Type: As above.

ICONES

R. Marloth, Fl. S. Afr. **1**: t. 31c (1913).

M. Vogts, Proteas, Know them & Grow them: 130 (1959).

A slender erect shrub to 2,0 m in height, very sparsely branched, stiffly erect, with a single main stem at base. *Flowering stems* slender, 3,0—4,0 mm in diam., densely tomentose. *Leaves* obovate-orbicular, occasionally elliptic, 1,0—2,5 cm long, 0,5—1,0 cm wide, entire; densely imbricate, covered with a softly villous adpressed indumentum. *Inflorescences* globose, 1,5—2,0 cm in diam., sessile, seldom solitary, usually 2—8 nate. *Involucral receptacle* flat, 4,0—5,0 mm wide. *Involucral bracts* broadly lanceolate to ovate, acute to obtuse 5,0—7,0 mm long, 2,0—5,0 mm wide, scarious to papyraceous, slightly sericeous towards the apex, otherwise glabrous, margins densely ciliate; arranged in 3 to 4 rows forming a distinct involucre. *Bracteoles* lanceolate acuminate, 6,0 mm long, 2,0 mm wide, densely lanate. *Perianth* yellow when fresh, becoming pinkish with age, 8,0—10,0 mm long, *Perianth tube* 4,0 mm long, glabrous, slightly quadrangular. *Perianth claws* equally reflexed subterminally, thickly villous. *Perianth limbs* elliptic 2,0 mm long very sparsely hirsute. *Style* 1,4—1,6 cm long, straight to very slightly incurved, tapering subterminally, yellow at first aging to crimson. *Pollen presenter* abruptly conic-ovoid, acute, 1,0 mm long, stigmatic groove terminal. *Hypogynous scales* filiform, obtuse, 1,5 mm long, hyaline.

Diagnostic Characters: The small, entire, densely imbricate, orbicular leaves, 1,0—2,5 cm long, the papyraceous involucral bracts which form a distinct involucre and the conic ovoid pollen presenter, distinguish *L. truncatulum* from related taxa.

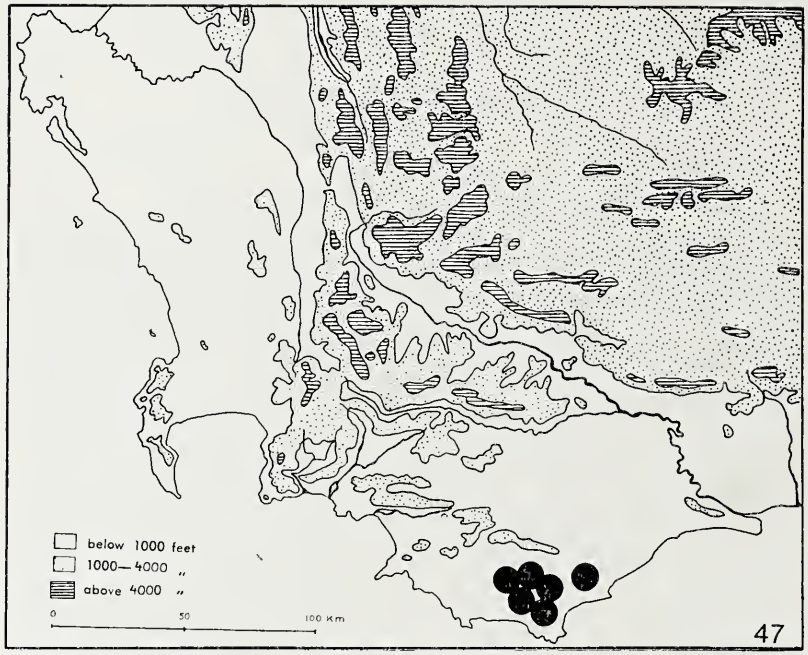
Distribution and Ecology: L. truncatulum extends from the eastern foothills of Kogelberg Peak, southwards to Bot River, Caledon, Hermanus and Bredasdorp, reaching the farm Springfontein (just north of Cape Agulhas) at the most southerly point of its range.

Solitary specimens or small stands are rarely encountered as this species tends to be gregarious, usually forming extensive communities. Most populations are found only in regions receiving a mean annual rainfall of 25—40″ p.a., mainly in winter. *L. truncatulum* favours south and east facing slopes at elevations ranging from sea level to 1 200 ft., where the associated, vegetation consists of dense sclerophyll composed mainly of Restionaceae Ericaceae and Proteaceae. Flowering takes place from August to December.

Specimens Examined:

CAPE

CALEDON: Elgin, along Highlands forest rd., Nov., *Esterhuysen* 20730 (BOL, PRE); Viljoens Pass, Nov., *Salter* 4035 (BOL, BM, K); Palmiet River, Elgin, Dec., *Stokoe* 8376 (BOL); Shaw's



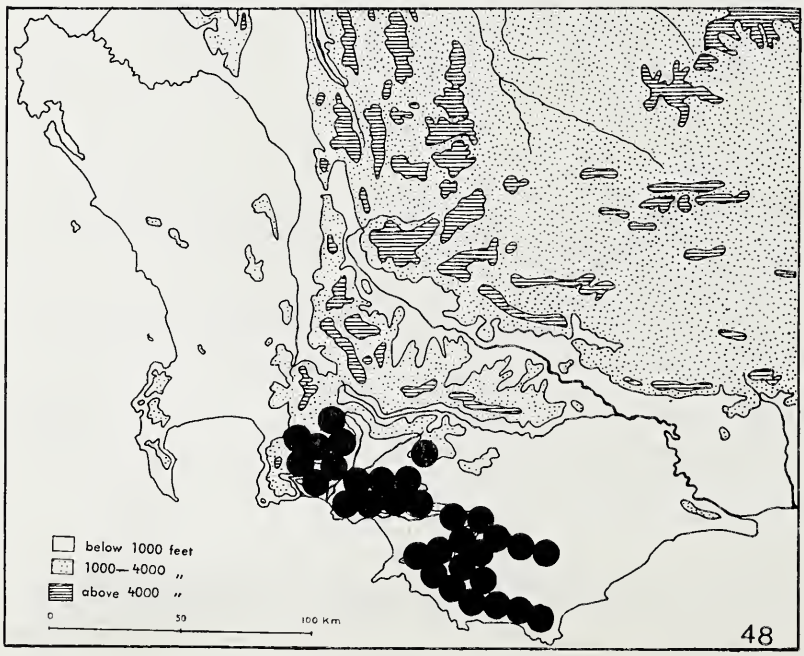


FIG. 47 AND 48.
(47) Distribution of *Leucospermum heterophyllum* (Thunb.) Rourke.—(48) Distribution of *Leucospermum truncatulum* (Salisb. ex Knight) Rourke.

Pass, Aug., *Stokoe* s.n. sub. SAM 65935 (SAM); Swartberg, Caledon, Oct., *Pappe* s.n. sub SAM 43646 (SAM); Prope Hangklip, Nov., *Krauss* s.n. (B); Between Bot River and Kleinmond, Dec., *Wall* s.n. (S); Hottentots Holland Kloof, *Auge* s.n. in herb. Bergius (SBT); Highlands, Aug., *Compton* 7890 (NBG); Sandbaai, July, *Walters* 2 (NBG); Sondagskloof, Dec., *Bond* 771 (NBG); Honingklip, Sept., *L. E. Taylor* 4085 (NBG); Foot of Onrust River mts., Feb., *Esterhuysen* 4956 (NBG); Between Aries Kraal and Louwsriver drift, Kogelberg, Dec., *Rourke* 1002 (NBG); Mountain at Onrust, April, *Brink* 71 (STE); Houw Hoek mountains, Oct., *Schlechter* 5495 (S, PRE, G, BM, SAM, K, BR, STE, Z); Fairfield, summit of Sondags Kloof Pass, *H. C. Taylor* 3627 (STE, PRE); In monte Houwhoek, *Krauss* s.n. (FI, M, Z); Swartberg, Caledon, *MacOwan* s.n. (GRA); Swartberg, Caledon, *Zeyher* 3685 (BOL, SAM), Kleyn river Kloof, Aug., *Zeyher* 3685 (BOL, PRE, K, S); Onrust, Dec., *van Niekerk* 347 (BOL, PRE); Hemel en Aarde, Dec., *Barker* 7616 (NBG); Hermanus, Oct., *Galpin* 4466 (PRE); Caledon, *Marloth* 4849 (PRE); Shaw's mountain, Dec., *Salter* 5163 (K); Flats at Grabouw, Aug. *Garside* 4454 (K); "Alpine places near Klein River", *Niven* s.n. (K); On the Houw Hoek mountain, *Bowie* s.n. (BM); Between Somersfontein and Aries Kraal, below Kogelberg, Jan., *Rourke* 1180 (NBG).

BREDASDORP: Haasvlakte forest reserve, Nov., *Hubbard* 179 (STE); Koude River, Dec., *Schlechter* 9603 (K, BM, PRE, G, BOL, BR, Z, S, PH); In collibus prope Elim, Dec., *Bolus* 8588 (BOL, NBG, K); Elands Kloof, Aug., *Esterhuysen* 5092 (BOL); Brandfontein, Oct., *Esterhuysen* 19065 (BOL); Ratel River, Sept., *Levyns* 8593 (CT); Between Elim and Hagedisberg Pass, Oct., *Levyns* 8436 (CT); Bredasdorp mountain, Dec., *Acocks & Hafstrom* 2105 (S); Baardscheerdersbosch, Dec., *Compton* 19020 (NBG); Near Elim on road to Pearly Beach, Nov., *Gill* 25 (NBG); Fairfield hills, Aug., *Barker* 8785 (NBG); Hills near Waterford, Aug., *Rourke* 520 (NBG); Eland's Kloof mts., above Papies vlei, Sept., *Rourke* 565 (NBG); Hills above Groenkloof, Kleyn Hagelkraal, Aug., *Rourke* 1084 (NBG); Hills above Avoca on Witelskloof farm, Sept., *Williams* 1236 (NBG); Bredasdorp mountain, *Galpin* 10507 (PRE, K); Sandrif near Napier, Oct., *van Breda* 1070 (PRE, K); Between Stanford and Elim, Nov., *Pole Evans* 4381 (PRE, K); Brandfontein, Nov., *Smith* 4987 (PRE, K); Springfontein, Sandy flats, Dec., *Rourke* 1172 (NBG).

WITHOUT PRECISE LOCALITY: Cape of Good Hope, *Ludwig* s.n. (NY, B); Prom. b. spei, *Masson* 16 (G); Cap. Bon. Spei, *Thunberg* in herb. Montini (S).

(38) **Leucospermum bolusii** Gandoger in Bull. Soc. bot. Fr. **48:** 95 (1901); Rourke in Jl S. Afr. Bot. **33:** 268 (1967). Type: In collibus prope Gordon's Bay, False Bay, Oct., *Bolus* 8077, (lectotype BOL, isotype PRE).

Leucospermum oleaefolium (Berg.) R. Br. var. *brownii* Meisn. in DC., Prodr. **14:** 261 (1856). Type: In Africa Capensi, *Gueinzius* s.n. in herb. Meisner (NY).

Leucospermum album Bond in Jl S. Afr. Bot. **7:** 200—202 (1941). Type: Gordon's Bay, *Mathews* s.n. (NBG 1327/29), (holotype NBG, isotype BOL).

ICONES

Bond in Jl S. Afr. Bot. **7:** 201 (1941)

Vogts, Proteas, Know them and Grow them: 127 (1959).

Eliovson, Proteas for Pleasure: 172—173 (1965).

Rice & Compton, Wild Flowers of the Cape of Good Hope, tab 146 (1951).

An erect to spreading, rounded shrub, to 1,5 m in diam., with a single main stem. *Flowering stems* erect, slender, 3,0—5,0 mm in diam., villous. *Leaves*

sessile, subimbricate, erect-ascending ovate elliptic 2,5—4,5 cm long, 0,75—1,5 mm wide; apex acute to obtuse usually entire, rarely bifid or trifid; glabrous, occasionally puberulous when young. *Inflorescences* numerous, up to 8 inflorescences per flowering shoot; depressed globose 2,0 cm in diam., pedunculate, peduncle, 1,0 cm long, 2,0 mm in diam., lanate. *Involucral receptacle* flat, 5,0—7,0 mm wide. *Involucral bracts* ovate-acute, 4,0—5,0 mm long, 2,0 mm wide, glabrescent with ciliate margins, reddish carmine in fresh state, texture soft and membranous: imbricate, aggregated to form a distinct cup-shaped involucre of about 3 whorls. *Bracteoles* lanceolate-acuminate, 7,0 mm long, 1,5 mm wide, densely villous to lanate, medianly canaliculate on inner surface. *Perianth* straight in bud, 12,0 mm long, creamy-white, becoming very pale pink with age. *Perianth tube* 5,0 mm long, glabrous proximally, puberulous distally, slightly quadrangular. *Perianth claws* densely villous, deflexed subterminally. *Perianth limbs* broadly lanceolate, 1,0 mm long, villous, reddish on outer surface when fresh. *Style* 1,5—2,0 cm long, straight, tapering subterminally. *Pollen presenter* conic ovoid, 0,75—1,0 mm long, pale greenish-yellow. *Hypogynous scales* hyaline, filiform, 1,0 mm long.

Diagnostic Characters: The conic ovoid pollen presenter, ovate glabrous leaves 2,5—4,5 cm long, the prominant involucre of imbricate, membranous, glabrous bracts with ciliate margins, and the creamy-white perianth, distinguish *L. bolusii* from related species.

Wilhelm Gueinzius made the first recorded collection of *L. bolusii* sometime between 1839 and 1841 during his period of residence at the Cape. This collection is the type of *L. oleaefolium* (Berg.) R. Br. var. *brownii* Meisn. The type of *L. bolusii* should be in Gandoger's herbarium at Lyon but the present author has been unable to trace it there, nor is it among the sheets of Cape Proteaceae at Zurich which were annotated by Gandoger and Schinz. Therefore, the duplicate at the Bolus herbarium has been designated the lectotype.

Distribution, Ecology and Biology: The range of *L. bolusii* extends from above Gordon's Bay to Kogelbay, a distance of about 7 miles. Throughout this very limited range the fairly dense populations grow in a narrow belt within a quarter of a mile of the sea and seldom above the 500 ft. contour. They occur on steep rocky slopes, on coarse Table Mountain Sandstone gravel, in a west facing position receiving a winter rainfall of 30—45″ p.a. The creamy white, sweetly scented inflorescences are produced from September to December. As the flower ages the white perianth becomes tinted with a pale pinkish hue.

Specimens Examined:

CAPE

SOMERSET WEST: Gordon's Bay, Sept., *Markotter* s.n. (STE 26116); Feb., *Markotter* s.n. (STE 8164); In collibus prope Gordon's Bay, Oct., *Bolus* 8077 (BOL, PRE); Gordon's Bay, Nov., *Mathews* s.n. NBG 1327/29 (BOL, NBG); Between 1st & 2nd streams, Gordon's Bay, Sept., *Lavis* s.n. (BOL 18536); Steenbras, Dec., *Middlemost* s.n. (BOL 18536, K); Steenbras Dam, Oct., *Middlemost* s.n. NBG 2010/26 (BOL); Between Gordon's Bay and Steenbras, Oct., *Levyns* 10783 (CT); Steenbras river mouth, Dec., *Lewis* 1646 (SAM); Slopes to the Steenbras river, Dec., *Acocks* 3945 (S); Steenbras river, Dec., *Hafstrom & Lindeberg* s.n. (S); Over Gordon's Bay, Dec., *Wall* 21 (S); Gordon's Bay, Sept., *Werdemann & Oberdieck* 131 (K); Gordon's Bay, Nov., *Parker* 4304 (NBG, K); Gordon's Bay cliffs, Oct., *Garside* 1311 (K); Steenbras river mouth, Oct., *Parker* 4002 (NBG, PRE, K); Between Steenbras mouth and Kogel Bay, Nov., *Gill* 13 (NBG); Roman Point between Gordon's Bay and Steenbras river mouth, Sept., *Rourke* 918 (NBG); Hills south of Gordon's Bay, Nov., *Marloth* 10014 (PRE); Heuning Kloof at Kogelbay, Nov., *Rourke* 1166 (NBG).

(39) **Leucospermum prostratum** (Thunb.) Stapf in Fl. Cap. **5:** 636 (1912).
Protea prostrata Thunb., Prodr. Pl. Cap. pars **1:** 27 (1794); Thunb., Fl. Cap. ed Schult.: 133 (1823); Roem & Schult. Syst. Veg. **3:** 355 (1818), R. Br. in Trans. Linn. Soc. Lond. **10:** 221 (1810). Type: E. cap. b. spei, *Thunberg* s.n., sheet 2962 in herb. Thunberg (UPS).
Leucadendron prostratum (Thunb.) Meisn. in DC., Prodr. **14:** 227 (1856).
Leucadendrum glomiflorum Salisb. ex Knight in Knight, Cult. Prot: 59 (1809); Phillips & Stapf in Fl. Cap. **5:** 551 (1912). Type: Not traced. "Sandy hillocks near Groot Hout Hoek", *Niven.*
Leucospermum diffusum R. Br. (Sensu Meisner), in DC. Prodr. **14:** 259 (1856), according to specimens quoted and seen in herb. Meisner (NY).

Prostrate plants with long trailing stems to 2,0 m in length; with numerous stems arising from an underground, persistent rootstock. *Flowering stems* trailing, slender, 1,0—2,0 mm in diam., softly puberulous, usually unbranched. *Leaves* linear to oblong acute, rarely obtuse entire, sessile, 2,0—4,0 cm long, 2,0—6,0 mm wide, sparsely villous to glabrescent, dull olivaceous, patent to subsecund. *Inflorescences* globose, 2,0—2,5 cm in diam., pedunculate; peduncle 1,0—3,0 cm long; usually solitary, occasionally 2 or 3 nate. *Involucral receptacle* flat, 6,0 mm wide. *Involucral bracts* lanceolate acute, 5,0—7,0 mm long, 1,0—1,5 mm wide, imbricate, cartilaginous, outer surface tomentose; apex crinite, cinereous. *Bracteoles* lanceolate acuminate 7,0 mm long, 2,0 mm wide, lanate, margins involute, clasping the perianth. *Perianth* 8,0—10,0 mm long, straight in bud, bright yellow at anthesis becoming deep orange with age. *Perianth tube* cylindric, 3,0 mm long, glabrous. *Perianth claws* sparsely villous, equally recurved subterminally. *Perianth limbs* narrowly lanceolate acute, scarcely differentiated from the claws; sparsely hispid. *Style* 1,2—1,5 cm long, straight,

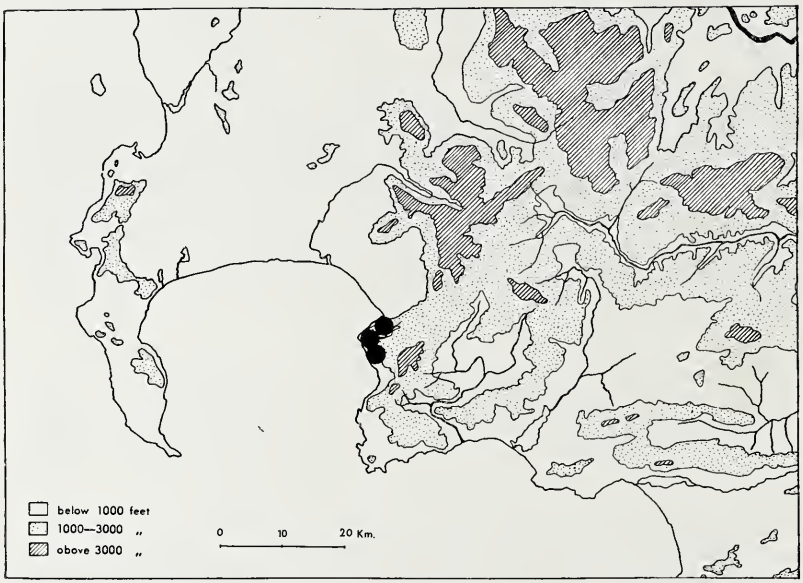


FIG. 49.
Distribution of *Leucospermum bolusii* Gandoger.

pale yellow at first, aging to orange. *Pollen presenter* cylindric obtuse, 1,0 mm long, stigmatic groove terminal. *Hypogynous scales* subulate 1,0 mm long.

Diagnostic Characters: L. prostratum is distinguished from *L. pedunculatum* by its diffuse prostrate growth habit, the slender, rarely branched trailing stems which arise from a stout subterranean rootstock, the small globose inflorescences 2,0—2,5 cm in diam., the cylindric obtuse to clavate styles and the perianth colour, bright yellow on opening, becoming deep orange with age.

Leucadendrum glomiflorum Salisb. ex Knight is included in the synonymy although no type material has yet been traced. However, Knight's very explicit description together with the information regarding its locality, leaves one in little doubt as to the identity of *L. glomiflorum*.

Distribution and Ecology: L. prostratum occurs from Kogelberg southwards along the coast to Betty's Bay, Houw Hoek, Hermanus, Stanford and Hagelkraal, extending inland to the Gansbaai, Papies Vlei and Elim hills.

This species grows mainly on sandy coastal flats. Populations occurring in hilly country appear to be confined to small areas of loose, sandy soil derived from weathered Table Mountain Sandstone A winter rainfall of 25–40″ p.a. is experienced throughout its distribution area. *L. prostratum* is a very fire resistant species able to withstand repeated burning. Regeneration of the aerial stems takes place from the crown of the subterranean rootstock. The sweetly scented inflorescences are produced from July to December.

Specimens Examined:

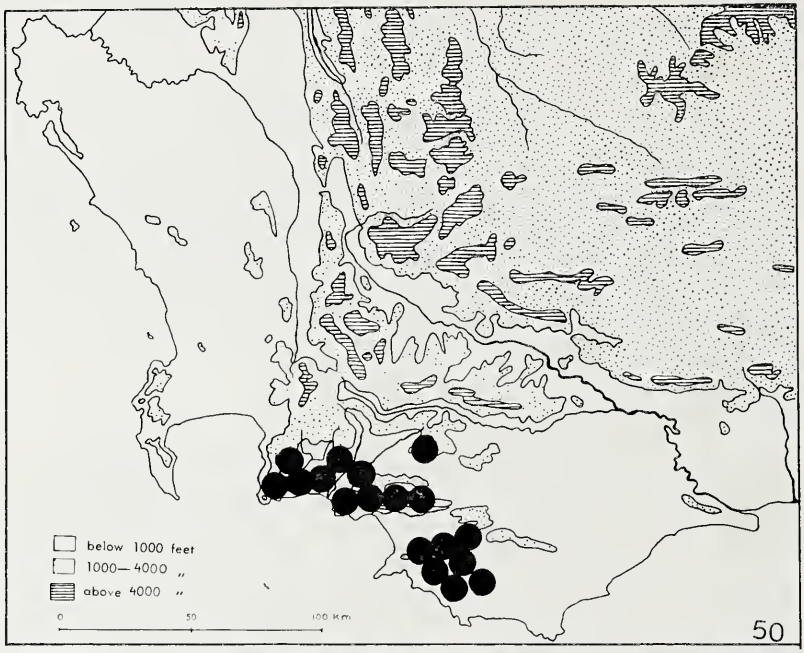
CAPE

CALEDON: Klein River mts., Sept., *Esterhuysen* 2909 (BOL); Palmiet River mts., *Stokoe* s.n. sub BOL 17520 (BOL); West base of Hangklip, Jan., *Pillans* 8202 (BOL); Kleinmond, near Palmiet River mouth, Jan., *M. C. Gillet* 596 (BOL); Kleinmond, Oct., *Levyns* 7750 (CT); Palmiet River mouth, April, *Levyns* 6340 (CT); South of Pringle Bay Peak, Sept., *Boucher* 625 (NBG); Kleinmond near harbour, Nov., *Rourke* 984 (NBG); Highlands, Sept., *Henderson* 1101 (NBG); Hills above Gansbaai, Aug., *Rourke* 506 (NBG); Fisherhaven near Hawston, July (in bud), *Williams* 786 (NBG); Betty's Bay, June, *Rourke* 485 (NBG); Hermanus rd. near Kleinmond, Sept., *Compton* 5878 (NBG); Klein river Vlei near Hermanus, Oct., *Williams* 48 (NBG); Cascades, Betty's Bay, *L. E. Taylor* 4394 (NBG); Three miles west of Stanford, July, *Williams* 807 (NBG); 15 miles south of Bot River, Nov., *Salter* 4060 (BM, K); Kogel Bay, Oct., *Werdermann & Oberdieck* 714 (PRE); Voelklip near Hermanus, June, *Bruyn* 187 (PRE); Hawston, Sept., *Marloth* 9205 (PRE); Diep Gat, Oct., *Galpin* 4465 (PRE, K); 2 miles west by north of Paviesvlei, July, *Acocks* 22453 (PRE, K); Plains between Kleinmond and Bot River, April, *Galpin* 12853 (PRE); Pringle Bay, Sept., *M. C. Gillet* 4210 (PRE); Houw Hoek & Swartberg, *Bowie* s.n. (K); Klein River, *Stokoe* 6563 (PRE, K); In arenosis ad Bot River, pone Hemel en Aarde, Aug., *Zeyher* 3686 (SAM, B, K, Z, BOL, PRE); In montibus Zwartbergen, pone Caledon, Oct., *Templemann* s.n. sub. 1641 in Herb. Norm. Aust. Afric. (SAM, K, Z); In monte Zwartberg, Caledon, Oct., *Pappe* s.n. sub SAM 19605 (SAM); Houw Hoek, Aug., *Compton* 7898 (NBG); Vogel Klip, Sept., *Barker* 1849 (NBG, PRE); Hangklip, Sept., *Compton* 13576 (NBG); Afdaks River near Hawston, Sept., *Rourke* 915 (NBG); Onrust River, Dec., *van Niekerk* 311 (BOL, PRE); Kleinmond, Sept., *Compton* 3403 (BOL, K); Road to Kogelberg Forest Reserve from Highlands, Oct., *Williams* 533 (BOL); Palmiet River, April, *Stokoe* 410 (STE); Papies vlei, July, *H. C. Taylor* 3612 (STE); Houw Hoek, Oct., *Schlechter* 5513 (GRA, BOL, BM, STE, SAM, PRE, BR, Z, K).

BREDASDORP: Eland's Kloof mts., above Papies Vlei, Sept., *Rourke* 570 (NBG); Stanford—Elim rd., Oct., *Baker* 1140 (BM); Strandkloof, Aug., *Compton* 21973 (NBG); 10 miles from Gansbaai on Elim rd., Sept., *Richmond* 27 (NBG); Baardscheerdersbos, Jan., *Barker* 5299 (NBG); Fransch Kraal, Nov., *Rycroft* 1753 (NBG); Frikkies Bay, Aug., *Compton* 18210 (NBG); Uilenkraal, Oct., *H. C. Taylor* 1600 (NBG); Between Waterford and Wolwegat, Sept., *Rourke* 569 (NBG); Kleyn Hagel Kraal, above Pearly Beach, Oct., *Rourke* 943 (NBG); Elim hills, Aug., *Compton* 9112 (NBG); Eland's Kloof, Aug., *Esterhuysen* 5093 (BOL); Sandy flats near Elim, Sept., *Levyns* 2156 (CT); Elim, April, *Schlechter* 7640 (GRA, K).

(40) **Leucospermum pedunculatum** Klotzsch in Krauss in Flora **28:** 76 (1845); Krauss, Beiträge Fl. Cap. und Natal.: 140 (1846). Type: "In arenosis planitiei Zoetendalsvalley, Dec., 38", *Krauss* s.n. lectotype (M), isotypes (Z, FI).
Leucadendron pedunculatum (Klotzsch in Krauss) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).

A low, prostrate shrub 15,0—30,0 cm in height, forming dense mats up to 3,0 m in diam., with a single stout erect main stem, to 30,0 cm in height, 1,0—



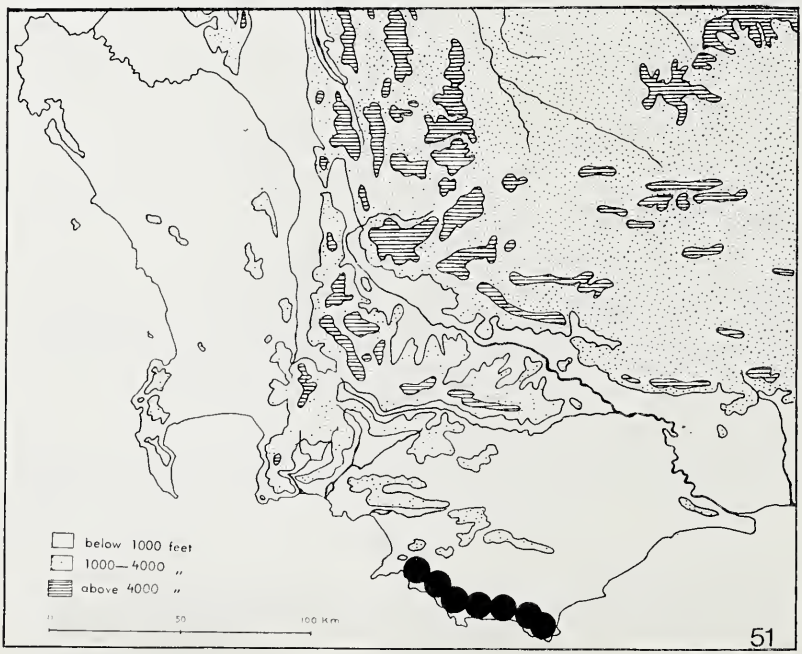


FIG. 50.
Distribution of *Leucospermum prostratum* (Thunb.) Stapf.

FIG. 51.
Distribution of *Leucospermum pedunculatum* Klotzsch.

15,0 cm in diam., from which arise stout, horizontally spreading branches. *Flowering stems* produced at the perimeter of the mat, trailing along the ground, usually bearing short lateral branchlets each terminating in an inflorescence; stems slender 2,0—3,0 mm in diam., puberulous. *Leaves* linear, occasionally slightly falcate 3,0—6,0 cm long, 2,0—5,0 mm wide, glabrous to minutely puberulous, distant, occasionally subsecund on trailing stems. *Inflorescences* globose, 2,5—3,0 cm in diam., usually solitary; prominently pedunculate, peduncle 2,0—4,0 cm long. *Involucral receptacle* very depressed-conic, almost flat, 4,0 mm high, 7,0 mm wide. *Involucral bracts* lanceolate acuminate, 6,0 mm long, 1,5 mm wide, cartilaginous, villous, rather loosely imbricate, the apices slightly recurved. *Bracteoles* oblanceolate, 7,0 mm long, 2,0 mm broad, apex mucronate, margins involute, outer surface thickly lanate. *Perianth* straight, cylindric in bud, pale cream to white becoming carmine with age. *Perianth tube* 7,0 mm long, glabrous proximally, villous distally, narrowed at base. *Perianth claws* equally recurved in the subterminal region, villous. *Perianth limbs* recurved, narrowly lanceolate acute, 2,0 mm long, hispid. *Style* straight 1,7—2,0 cm long, pale cream becoming carmine with age. *Pollen presenter* clavate cylindric, acute, 1,5 mm long, stigmatic groove terminal. *Hypogynous scales* linear, 1,0 mm long, hyaline.

Diagnostic Characters: L. pedunculatum may be distinguished from *L. prostratum* with which it has been confused, by its stout, erect main stem, up to 30,0 cm in height and up to 15,0 cm in diam. The horizontally spreading branches terminate in flowering stems which usually bear short lateral branchlets, each branchlet producing an inflorescence. Living material may be distinguished by the creamy-white inflorescences, which become carmine with age, and the bright green colour (R.H.S. 144 B) of the foliage.

The name *L. pedunculatum* Klotzsch has been consistently misapplied since its publication in 1845. Both Meisner and Phillips assumed it to be a synonym of *L. saxatile* (Salisb. ex Knight) Rourke (= *L. diffusum* R. Br.). The original collection was made by Krauss in Dec. 1838 "In arenosis planitiei Zoetendalsvalley". Krauss described his visit to Soetendalsvlei as follows: "Round the salt pans the ground is covered with *Samolus campanuloides* R. Br. . . . and the hills of marine lime were beautified by the lovely *Leucospermum pedunculatum* Klotzsch n. sp., and other plants". (Krauss, 1846.)

When the type material was examined it appeared to resemble a slender depauperate twig of *L. prostratum* (Thunb.) Stapf, but as *L. prostratum* does not occur near Soetendalsvlei nor on the adjacent limestone hills of the Soetanysberg, it is unlikely to be this species. Unfortunately, no information regarding the colour of the perianth is provided which would at once have established its identity.

The type locality was therefore visited in December 1968. A collection was made a quarter of a mile south east of the homestead Springfontein which lies on the sandy flats between Soetendalsvlei and the foothills of the limestone Soetanysberg. Several flowering stems from this collection match the type material very closely. Thus, despite the fact that *L. pedunculatum* was described from rather atypical material obtained at the extreme eastern end of its range, a careful search of the type locality for material matching the type specimen, has made it possible to apply this name to living populations with a fair degree of certainty.

Distribution and Ecology: L. pedunculatum is confined to a narrow strip of the Southern Cape coast between Franskraal near Danger Point and Springfontein near Cape Agulhas.

All known populations are found in fairly close proximity to the sea, generally with 2 miles of the coast and never occurring more than 4 miles inland from the coast. The altitudinal range is also small, being from sea level to 600 ft. Most populations grow on the flats skirting the ridge of limestone hills which lie adjacent to the coast, on deep white sandy soils of Tertiary or Recent origin. Occasionally plants are found on small areas of wind blown sand that have accumulated between the limestone hills but they are never found growing on limestone. At higher elevations *L. pedunculatum* occurs on weathered Table Mountain Sandstone. A rather low winter rainfall of 15–25″ p.a. is experienced throughout its distribution range.

L. pedunculatum has a certain degree of fire resistance. If the peripheral branches are burnt off, regeneration frequently takes place from the crown of the trunk, but recovery seems to depend on the intensity of the fire.

Between August and January, the very sweetly scented inflorescences are produced, the peak of the flowering season being in September. On opening, the perianth is creamy-white, changing to pink and later to carmine.

Plants from the western end of the distribution range form large dense mats. They are further characterised by the bright green foliage and the numerous axillary branchlets produced by the flowering stems. This form gradually grades into less vigorous plants towards the eastern end of the distribution range which are more diffuse, produce few axillary branchlets (or none at all) on the flowering stems and have rather more olivaceous foliage, but develop a taller and more prominent main stem.

At Kleyn Hagel Kraal, *L. pedunculatum* and *L. prostratum* occur sympatrically (within 5 metres of each other) but no hybridization has ever been observed between these two species.

Specimens Examined:

CAPE

BREDASDORP: Danger Point mountain, Jan., *Leighton* 1596 (BOL, PRE); Hagelkraal River, Dec., *Leighton* 2536 (BOL); Ratel River, Jan., *Rycroft* 1852 (NBG, BOL); Zoetanysberg, Oct., *H. C. Taylor* 145 (BOL); Franskraal, Aug., *Leighton* 1883 (BOL); Brandfontein, sandy flats, Oct., *Esterhuysen* 19065 (BOL); Pearly Beach, Jan., *Lewis* 2595 (SAM); Frikkies Bay, Aug., *Compton* 18180 (NBG); Near Vogelvlei between Elim & Bredasdorp, Aug., *Williams* 478 (BOL); In ericetis prope Elim, Dec., *Bolus* 8587 (BOL); In montibus prope Elim, Oct., *Bolus* 7872 (BOL, PRE); Between Gansbaai and Baardscheerdersbos, Oct., *Levyns* 10879 (CT); Springfield estate, Sept., *Stokoe* s.n. sub SAM 62121 (SAM); In arenosis planitiei Zoetendalsvalley, Dec., *Krauss* s.n. (M, FI, Z); Gansbaai, Sept., *Gillet* 4328 (PRE); Dirk Uys Kraal, Aug., *van Breda* 835 (PRE); Ratel River estate, Oct., *van Breda* 1467 (PRE); Sandy hills above Hagelkraal, Sept., *Rourke* 530 (NBG); Kleyn Hagelkraal above Pearly Beach, Oct., *Rourke* 942 (NBG); Groenkloof, Kleyn Hagel Kraal, Sept., *Rourke* 1086 (NBG); Heidehof near Uilenkraal River, Dec., *Rourke* 1011 (NBG); Springfontein, ¼ mile south of homestead, Dec., *Rourke* 1174 (NBG); Hagelkraal, Jan., *Compton* 20435 (NBG); Springfield, Jan., *Rycroft* 1826 (NBG); Franskraal, Nov., *Rycroft* 1754 (NBG); Hills one mile north of the Soetanysberg, Dec., *Rourke* 1015 (NBG); Soetanysberg, north slopes, Dec., *Rourke* 1018 (NBG); One mile inland from Die Dam, Sept., *Esterhuysen* 32099 (NBG); Bo Vogelvlei, road to Soetanysberg, Oct., *Williams* 1321 (NBG); Soetanysberg, east of Rietfontein, Oct., *Rourke* 1128 (NBG); Between Jacobsdam and Geelrug, north of Soetanysberg, Oct., *Rourke* 1123 (NBG); Waterford, between Viljoen's Hof and Hagelkraal, Oct., *Rourke* 1134 (NBG); Brandfontein, Nov., *Smith* 5001 (PRE); Brandfontein, at foot of Soetanysberg, Nov., *Smith* 5012 (PRE); Bredasdorp mountains, Nov. *Galpin* 10502 (PRE).

Sect. 8. XERICOLA Rourke, sect. nov.

Foliis integris, glabris, glaucis, ovatis-ellipticis vel linearis spathulatis, cartilagineis, crassis. Inflorescentiae globosae, 1,0—2,5 cm in diam. Perianthium roseum. Stigmate clavata. Bracteolae demum accrescentes, lignescentes.

Leaves entire, glabrous, glaucous, ovate-elliptic to linear spathulate, thick and cartilaginous, Inflorescences globose, 1,0—2,5 cm in diam. Perianth pink or whitish-pink. Stigma clavate. Bracteoles becoming enlarged and woody after pollination.

Type: *L. alpinum* (Salisb. ex Knight) Rourke.

The section Xericola is a very natural group characterised by the small rather few flowered globose inflorescences, the thick, glaucous, entire leaves, the pink perianth and the bracteoles which enlarge and become woody in the post pollination phase. Apart from the very distinct *L. secundifolium*, the remaining material which had been assigned to *L. alpinum* and *L. obtusatum*, appeared to belong to a single variable complex. Leaf length appeared to be the only significant variable character as the floral parts except for differences in style length were very similar in all the material. In material referred to *L. alpinum* the range in style length is 1,2—1,7 cm while in *L. obtusatum* it is 1,0—1,3 cm. Initially, an inspection of all available material suggested that there was an even gradation from linear-spathulate to obovate-spathulate leaves. However, closer inspection revealed that the broader leaved forms were from northerly localities while the narrower leaved forms were from southerly localities. Moreover, in the narrower leaved forms a fine indumentum of short, crisped hairs persists on the foliage for several months while the broader leaved forms are quite glabrous.

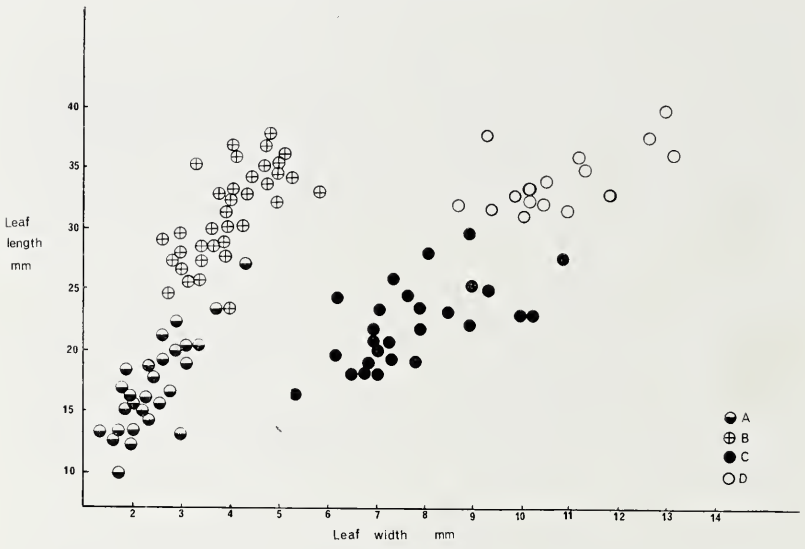


FIG. 52.
Scatter diagram showing variation in the leaf dimensions of *Leucospermum obtusatum* (Thunb.) Phillips ssp. *obtusatum* (A); *L. obtusatum* (Thunb.) Phillips ssp. *albomontanum* Rourke (B); *L. alpinum* (Salisb. ex Knight) Rourke ssp. *alpinum* (D) and *L. alpinum* (Salisb. ex Knight) Rourke ssp. *amoenum* Rourke (C).

In order to investigate the significance of leaf dimensions in relation to locality, the lengths and widths of accurately localised specimens in BOL, SAM, NBG, CT, PRE and K were plotted as a scatter diagram. Each measurement was scored to indicate locality (fig. 52). A gap separating the complex into two main groups is apparent while two less clearly defined subgroups may be distinguished within each of the main groups. These four groups represent four isolated montane populations occurring in areas bordering the Karroo, above 3 000 ft. and growing in Arid Fynbos. Effective reproductive isolation is achieved by the presence of intervening karroid areas (fig. 53).

The gap between the two main groups is regarded as being sufficiently marked to recognise them at specific level as *L. obtusatum* and *L. alpinum* respectively (fig. 52). No absolute disjunctions between the subgroups are discernible in the diagram although it is clear that each species is composed of two local races.

Field observations revealed that in the case of *L. obtusatum* the shorter leaved form was consistently decumbent with trailing stems and secund leaves.

The Witteberg population is composed entirely of upright plants with erect stems and considerably longer leaves. For these reasons this latter population is here described as a distinct subspecies of *L. obtusatum*.

In *L. alpinum*, apart from the considerable geographical disjunction between the two populations as well as differences in the leaf length, the Cold Bokkeveld-Swartruggens material is characterised by the presence of prominent involucral bracts. The typical population from the Kamiesberg is characterised by a poorly developed, indistinct involucre.

Consequently, it is now proposed that the Cold Bokkeveld-Swartruggens populations be recognised as a hitherto undescribed subspecies of *L. alpinum*.

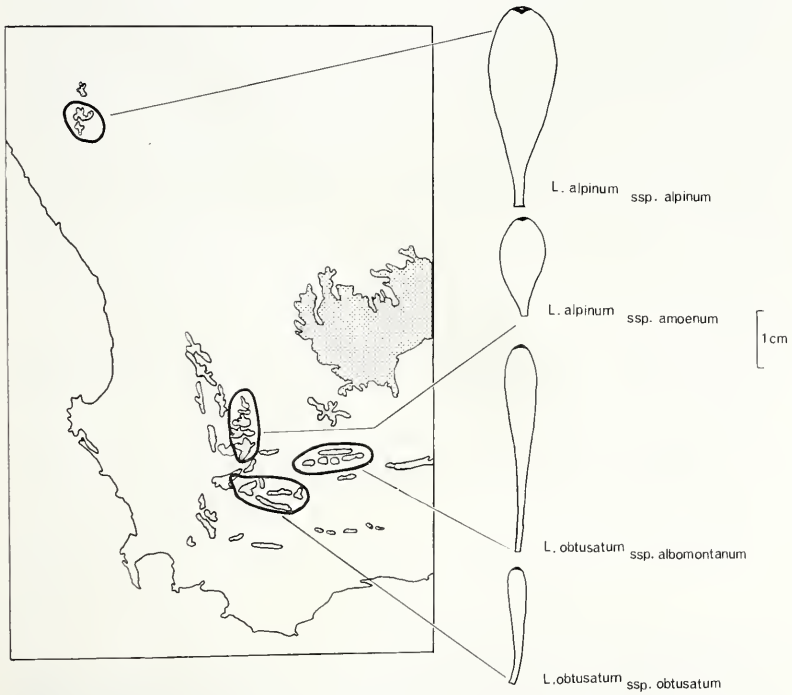


FIG. 53.
Distribution of *Leucospermum alpinum* (Salisb. ex Knight) Rourke and *L. obtusatum* (Thunb.) Phillips showing the ranges of their subspecies. Outlines of leaves regarded as being representative of each subspecies are shown.

(41) **Leucospermum alpinum** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **33:** 266 (1967).

An erect to suberect shrub to 1,5 m in height; with a single main stem at base, trunk to 5,0 cm in diam., lowermost branches tending to sprawl along the ground. *Flowering stems* erect or slightly spreading; terete, 3,0 mm in diam., puberulous, soon becoming glabrous. *Leaves* obovate to spathulate-elliptic, 1,5—4,0 cm long, 0,5—1,3 cm wide; usually distinctly petiolate, entire, glabrous, thick and coriaceous with a prominent margin and a yellowish callous at apex; subimbricate to slightly patent. *Inflorescences* solitary, globose, 1,5—2,0 cm in diam., sessile or pedunculate, peduncle up to 1,5 cm long; inflorescences occasionally terminal. *Involucral receptacle* ovoid to spherical, 5,0 mm in diam. *Involucral bracts* lanceolate, acute to acuminate densely lanate, apex hardened and glabrous; 6,0 mm long, 1,5 mm wide, uniseriate or 3–4 seriate. *Bracteoles* ovate-lanceolate, acute, very densely lanate, 5,0 mm long, 2,0 mm wide. *Perianth* 1,3—1,8 cm long, straight in bud, pale pink when fresh, limbs deep claret. *Perianth tube* 2,0—2,5 mm long, glabrous. *Perianth claws* villous to densely villous, becoming coiled at anthesis. All 4 claws of equal length, free, spreading at right angles. *Perianth limbs* elliptic 2,0 mm long, tomentose-villous. *Style* straight, 1,2—1,7 cm long, pale pink to carmine at anthesis becoming deep claret with age. *Pollen presenter* clavate 1,5 mm long, brownish at first, becoming deep purple to black. *Ovary* ellipsoid-ovoid 1,0 mm long, pubescent, clearly differentiated from style. *Hypogynous scales* 1,0 mm long, subulate, yellow.

Diagnostic Characters: The thick, glabrous, slightly glaucous entire obovate to spathulate-elliptic leaves which are 1,5—4,0 cm long and 0,5—1,3 cm wide, distinguish *L. alpinum* from related species.

Key to the subspecies

Leaves 3,0—4,5 cm long, involucre indistinct, uniseriate, puberulous; confined to Kamiesberg.

.....ssp. *alpinum*

Leaves 1,5—3,0 cm long, involucre prominent, 3–4 seriate, lanate; confined to Cold Bokkeveld & Swartruggens.

.....ssp. *amoenum*

(a) ssp. **alpinum**

Protea alpina Salisb. ex Knight in Knight, Cult. Prot.: 27 (1809). Lectotype: "On the high peak of Khamiesbergh, *Niven* 47 (PH), isotype in herb. J. E. Smith (LINN).

Leucadendron cartilagineum R. Br. in Trans. Linn. Soc. Lond. **10:** 67 (1810). Presumed type: *Niven* 47 in herb. J. E. Smith (LINN).

Protea cartilaginea (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 557 (1816).

Leucospermum cartilagineum (R. Br.) Phillips in Fl. Cap. **5:** 636 (1912).

An erect shrub to 1,5 m in height. *Leaves* obovate to spathulate-elliptic, 3,0—4,5 cm long, 8,5—13,0 mm wide, distinctly petiolate. *Inflorescences* globose, 2,0 cm in diam.; involucre indistinct, involucral bracts uniseriate, puberulous.

No type material of *Protea alpina* could be traced in Salisbury's herbarium at Kew, but the Academy of Natural Sciences, Philadelphia (PH) possesses a considerable number of specimens of Cape Proteaceae collected by Niven, including two duplicates of his original collection of *Protea alpina.* One of these sheets bears a ticket in Niven's hand which reads "Protea 3 or 4 ft. high on the high peak of Khamiesbergh". As Knight uses this phrase verbatim in the type description, this sheet has been designated the lectotype of *P. alpina.* A duplicate of this collection is in Smith's herbarium (LINN) and is annotated "Cap b. spei—Hibbert 1801" in Smith's handwriting. I consider that this sheet is the type of *Leucadendron cartilagineum* R. Br. since Brown merely remarks "v.s. in Herb. Soc. Linn. et D. Hibbert.", without mentioning any collector.

Distribution, Ecology and Biology: The only *Leucospermum* found in Namaqualand, *L. alpinum* ssp. *alpinum*, is confined to the Kamiesberg Range where it occurs on the higher peaks between 4 500 ft. and 5 500 ft. at Leliefontein, on Ezelskop, Welcomekop and Roodeberg.

Archaean granite and soils derived from it make up the substratum throughout this area. Most populations are apparently confined to the upper slopes of the peaks in both north and south facing positions. The average annual rainfall at Leliefontein (4 700 ft.) is 12,7″. Eighty per cent of the precipitation falls in winter and the figure quoted is probably fairly representative of the whole of the Kamiesberg complex, although during this period a maximum of 20,6″ and a minimum of 7,4″ p.a. was recorded (Adamson, 1938: 5). The associated vegetation is composed mainly of hardy outliers of genera such as *Passerina, Cliffortia* and *Metalasia.* Flowering takes place from September to November.

Specimens Examined:

CAPE

NAMAQUALAND: Leliefontein, Roodeberg, Ezelkop, Nov., *Drège* s.n. (M, NY, B, SAM, S, G, PRE, K, BM); Leliefontein, 4500 ft, 3/11/1830, *Drège* s.n. (P); Roodeberg, 4,000—5,000 ft, 10/11/1830, *Drège* 2417 (P, B); Kamiesbergen, May, *Marloth* 4865 (PRE); Leliefontein, Kamiesbergen, *Marloth* 8758 (PRE); Ezelkop, near summit, Kamiesberg, Oct., *Adamson* 1466 (CT, PRE); Leliefontein, Kamiesberg, Feb. (in fruit), *George* s.n. (STE 19567); Beacon Hill, north west of Leliefontein, Jan. (in fruit), *Pearson* 6330 (BOL, SAM, K); Near Leliefontein, Sept., *Levyns* 4003 (CT); Welcome, Kamiesberg, Oct., *Esterhuysen* 23735 (BOL); "On the high peak of Khamiesbergh", *Niven* 47 (PH, LINN).

WITHOUT PRECISE LOCALITY: Africa australis, *Roxburgh* s.n. (BM); Prom. bon. spei, *Roxburgh* s.n. (G).

(b) ssp. **amoenum** Rourke, ssp. nov.

Distinguitur a subspecie typica, foliis brevioribus (1,5—3,0 cm longis), involucro distincto, 3–4 seriato bracteis dense lanatis.

An erect to suberect shrub, to 1,0 m, the lowermost branches tending to trail along the ground. *Leaves* obovate, entire, apex rounded, 1,5—3,0 cm long, 5,0—11,0 mm wide. *Involucre* prominent, 3–4 seriate, involucral bracts thickly lanate.

Type Material: Ceres district, at Katbakkies, Swartruggens Range between Cold Bokkeveld and Ceres Karoo, 22nd Oct. 1967, *Rourke* 958 (holotype, NBG).

Distribution and Ecology: L. alpinum ssp. *amoenum* is confined to the south Cold Bokkeveld and the southern end of the adjacent Swartruggens range.

Unlike the typical subspecies which occurs exclusively on Archaean granite, *L. alpinum* ssp. *amoenum* grows only on Table Mountain Sandstone. This environment is slightly more moist than the Kamiesberg, experiencing 10–20″ of rain p.a. Hot, dry, very rocky north facing slopes are the favoured habitat. The associated vegetation is Arid Fynbos, composed mainly of low, sparse Restionaceae, Ericaceae and Proteaceae. Flowering takes place between September and November.

Specimens Examined:

CAPE

CERES: Near Zandberg, south Cold Bokkeveld, Oct., *Esterhuysen* 3449 (BOL, PRE, K); Ertjiesland Kloof, Nov., *Leighton* 2260 (BOL, PRE); Baviaansberg, Jan., *Stokoe* 4547 (BOL); Ceres, Nov., *Tijmens* 14 (STE); Dwarsberg, Ceres, Cold Bokkeveld, Sept., *Levyns* 1942 (CT, K); Baviaansberg, Jan., *Stokoe* s.n. (SAM 68375); Gydo, Nov., *Compton* 18712 (NBG); Road to the Ceres Karroo beyond Houdenbek, Sept., *Williams* 891 (NBG); Baviaansberg, Nov., *Esterhuysen* 29842 (NBG); South Cold Bokkeveld, Oct., *Bond* 647 (NBG); Katbakkies, Swartruggens Range, between Cold Bokkeveld and Ceres Karroo, Oct., *Rourke* 958 (NBG).

WITHOUT PRECISE LOCALITY: C.B.S., *Mund* s.n. (K).

(42) **Leucospermum obtusatum** (Thunb.) Phillips in Fl. Cap. **5:** 637 (1912).

An erect to suberect or sprawling to decumbent shrub 20,0 cm—1,0 m in height, 1,0—2,0 m in diam. *Flowering stems* erect or trailing, 1,0—2,0 mm in diam., thinly puberulous with fine crisped hairs, soon glabrous. *Leaves* linear-spathulate, entire, 0,9—3,8 cm long, 1,5—6,0 mm wide, apex rounded, obtuse. Leaves dull grey—glaucous, puberulous at first becoming glabrous; stiffly erect-ascending or secund. *Inflorescences* terminal, globose, 1,5—2,0 cm in diam. *Involucral receptacle* depressed globose 3,0—4,0 mm in diam. *Involucral*

bracts ovate acute, 6,0—8,0 mm long, 2,0—4,0 mm broad, outer surface thickly tomentose to lanate; bracts imbricate, cartilaginous, uniseriate. *Bracteoles* ovate-acute, 5,0—7,0 mm long, 2,5—3,0 mm wide, thickly lanate, tightly clasping the perianth. *Perianth* 1,0—1,5 cm long, straight, the 4 perianth claws becoming equally recurved at anthesis; cream or pink in fresh state. *Perianth tube* 2,0—3,0 mm long, slightly quadrangular, glabrous. *Perianth claws* filiform, the outer surface beset with a fine crisped indumentum. *Perianth limbs* lanceolate-acute, 3,0 mm long, outer surface very shortly villous. *Anthers* sessile, elliptic, 2,5 mm long, apical boss pointed, black. *Style* 1,0—1,3 cm long, straight, pale yellowish-green at first becoming deep claret coloured with age. *Pollen presenter* clavate-obtuse, 1,5—2,0 mm long, greenish when fresh becoming amber with age. Stigmatic pore terminal, minute. *Ovary* ovoid, 1,0 mm long very clearly differentiated from style, pubescent. *Hypogynous scales* subulate, hyaline, 1,0 mm long.

Diagnostic Characters: The entire, linear-spathulate leaves, 1,5—6,0 mm wide, attenuate to petiolate at the base, distinguish *L. obtusatum* from all other species in the genus.

Key to the subspecies

Stems decumbent or trailing, leaves secund, 10—25 mm long. ssp. *obtusatum*.

Stems erect, leaves loosely ascending imbricate, 22—38 mm long. ssp. *albomontanum*.

(a) ssp. **obtusatum**

Protea obtusata Thunb. in Phytogr. Blätt. **1:** 15 (1803). Type: Cap. b. spei, *Thunberg* s.n., sheet no. 2946 in herb. Thunberg (holotype, UPS).
Protea obtusa Thunb. in Nova Acta Acad. Sci. Imp. Petrop. Hist. Acad. **15:** 461, tab. 3 fig. 2 (1806). Type: As for *P. obtusata*.
Leucadendron obtusatum (Thunb.) Meisn. in DC., Prodr. **14:** 227 (1856).

A sprawling decumbent shrub with stems trailing along the ground; forming dense mats 1,0—2,0 m in diam. *Leaves* secund to sub-secund, linear-spathulate, 1,0—2,5 cm long, 0,5—4,5 mm wide.

Apart from the vague "Cap. b. spei", Thunberg, who first collected and described this species provides no further information concerning its exact locality. Nevertheless, from the trailing items with secundly arranged leaves on the type specimen, one may deduce that Thunberg made this collection in the Koo-Montagu-Waboomberg area. The only occasion on which he passed close to this area was in mid October 1772. This clue is provided in Thunberg's

"Travels" where we learn that the party proceeded "to Riet Fontein and further over Clas Vogts Rivier to a farm which at this time belonged to one Le Roux". From the vicinity of Klaas Voogds it would not have been impossible for Thunberg to make an excursion into the surrounding Langeberg where he would have encountered *L. obtusatum ssp. obtusatum*.

Distribution and Ecology: Although *L. obtusatum ssp. obtusatum* is mainly centred around the Waboomsberg and Koo mountains in the Montagu district, its range extends westwards to the Worcester district where it has been recorded on the Keeromsberg, Matroosberg and at Bokkeriver.

This subspecies inhabits dry rocky slopes of Table Mountain Sandstone in an area receiving a winter rainfall of 10–15″ p.a. Most populations occur above 3 000 ft. The veld type in which they occur is Arid Fynbos and the associated vegetation consists mainly of low *Restionaceae* and *Cliffortia ruscifolia* with *Protea repens*, *P. lorifolia* and *P. sulphurea* being the more significant larger shrubs. The mature shrub seldom exceeds 20,0 cm in height but develops into a dense spreading mat up to 2,0 m in diam., with stems radiating from a stout trunk and trailing over the ground. From September to December the sweetly scented cream to pink inflorescences are produced, usually on the young shoots at the perimeter of the old plants.

Specimens Examined:

CAPE

MONTAGU: Top of pass between Concordia and Eendracht, Oct., *Michell* 305 (PRE, CT); Wagenboomsbergen, Dec., *Compton* 10286 (NBG, BOL); Eendracht, Wagenboomsbergen, Sept., *Compton* 18388 (NBG, BOL); Eendracht, Sept., *Lewis* 1645 (SAM); Concordia and Triangle, Oct., *Barnard* 683 (SAM); Waboomsberg, April, *Williams* 727 (NBG); Koo Mountains, Nov., *Oliver* s.n. (NBG 40111); On the Waboomsberg at Brakkefontein, Oct., *Rourke* 1163 (NBG); Waboomsberg, at Highlands, Oct., *Rourke* 1164 (NBG).

WORCESTER: Keeromsberg, shale band S.W. side, Nov., *Esterhuysen* 9286 (BOL); Keeromsberg, shale band below Ben Heatlie, March, *Esterhuysen* s.n. (BOL); Keeromsberg, Koo valley side, April, *Esterhuysen* 22895 (BOL); Matroosberg, *K. L. Davidson* 15 (K), 37 (SAM).

CERES: Bokkeriver Farms, Nov., *Horrocks* 127 (NBG).

(b) ssp. **albomontanum** Rourke, ssp. nov.

L. obtusatum ssp. *albomontanum* a habitu erecto, folis linearibus spathulatis integris, laxe imbricatis assurgentibus, 2,2—3,8 cm longis, distinguitur. Folia longiora quam subspecie typica sunt.

An erect to rather spreading shrub, 1,0 m in height, 1,0 m in diam., single stemmed at base. *Flowering stems* erect with leaves loosely ascending imbricate. *Leaves* entire, linear-spathulate, glabrous, 2,2—3,8 cm long, 2,5—5,5 mm wide.

Type Material: Summit of the Witteberg at Bantams, 29th Oct. 1968, *Rourke* 1161 (holotype, NBG).

Distribution, Ecology and Biology: L. obtusatum ssp. *albomontanum* is distributed along the entire length of the Witteberg and also occurs on the adjacent Bonteberg.

Throughout its range, this subspecies grows exclusively on soils derived from quartzites of the Witteberg series. This is in contrast to the typical subspecies which occurs only on Table Mountain Sandstone. At most places on the Witteberg it is very common particularly along the summit ridge and on the upper south slopes, even extending down the hot north facing slopes in sheltered kloofs. The plants grow wedged between sharp angular quartzite fragments on very rocky scree-like slopes, between 4 000 and 5 000 ft. The associated vegetation consists mainly of sparsely scattered tufts of *Restionaceae*, *Erica spectabilis*, *Protea lorifolia*, *P. harmeri* and *Leucadendron cadens*. A very low winter rainfall is experienced. No exact rainfall figures are available for the summit of the Witteberg but it is unlikely to be more than 10″ p.a., since the mean annual rainfall of Matjiesfontein is 6″ and that of Whitehill is 5″ (Compton, 1931: 269). Both these villages are situated at the foot of the Witteberg, 2 000 ft. below the summit ridge. The very arid nature of this environment cannot be overemphasised as the average annual rainfall experienced here is barely sufficient to maintain a cover of Cape Flora or "Fynbos". Levyns (1938: 414) considered that a mean annual rainfall of 10″ or more is necessary to support Cape Flora.

If left unburnt, plants of *L. obtusatum* ssp. *albomontanum* will reach a height of 1,0 m or more. The pink to carmine coloured inflorescences are sweetly scented and are produced between August and November.

Specimens Examined:

CAPE

LAINGSBURG: Witteberg near Matjiesfontein, Nov., *J. D. Logan* s.n. no. 11555 in herb. Marloth (PRE); Witteberg, Oct., *Leighton* 209 (BOL); Witteberg near Whitehill, Nov., *L. E. Taylor* 1248 (BOL); Witteberg near Matjiesfontein, Oct., *Marloth* 4539 (BOL); Tweedside, Witteberg Ridge, Oct., *Compton* 3265 (BOL, BM, NBG, K); Witteberg, Jan., *Esterhuysen* 28884 (BOL, NBG); Summit of the Witteberg, June, *Compton* 2556 (BOL); Witteberg, Matjiesfontein, Sept., *Thoday* s.n. (SAM 25281); Witteberg, Nov., *Compton* 2823 (BM, K); Top of Witteberg, Oct., *Compton* 39169 (BM); Witteberg, Whitehill, south slope, Aug., *Compton* 2514 (BM); Witteberg at Whitehill, Oct., *Compton* 13933, 7952 (NBG); Witteberg, Bantams, Oct., *Compton* 12180 (NBG); Summit of the Witteberg at Bantams, Oct., *Rourke* 1161 (NBG).

CERES: Bonteberg, Nov., *Compton* 9924 (NBG); Eikenbosch hoek, Bonteberg, summit of ridge, Nov., *Esterhuysen* 3700 (BOL, K, PRE).

(43) **Leucospermum secundifolium** Rourke, sp. nov.

Species insignis, a speciebus omnis nanis prostratis mihi notis bene distincta propter caules graciles serpentes, folia petiolata secunda distantes, angusta elliptica, obtusa, et inflorescentias parvulas floribus paucis.



FIG. 54.
Leucospermum secundifolium Rourke. (1) Flowering shoot; (2) involucral bracts showing dorsal and ventral surfaces; (3) style; (4) flower. From the type collection, *Esterhuysen* 26835.

Frutex humilis, diffusus. *Caules* graciles, serpentes, 1,5—2,0 mm in diam. *Folia* glabra, petiolata, elliptica, secunda, 5,0—8,0 cm longa, 0,7—1,6 cm lata. Petiolus 1,0—2,0 cm longus. Apex obtusus, integrus, raro tridentatus. *Inflorescentia* globosa, 1,0—1,5 cm in diam. *Bracteae* involucrali, uniseriatae, lanceolatae acuminatae, 6 mm longae, 2 mm latae. *Perianthium* 1,6 cm longum, rectum. *Stylus* filiformis, 1,4 cm longus, rectus. Stigma 1,0 mm longa, clavata.

A low, prostrate, decumbent shrub, with slender rather diffuse stems, trailing over the ground. *Stems* very slender, 1,5—2,0 cm in diam., new growths villous to lanate, but soon quite glabrous. *Leaves* glabrous, petiolate (petiole 1,0—2,0 cm long) elliptic obtuse, 5,0—8,0 cm long, 0,7—1,6 cm wide; apex obtuse with a single callus tooth, or occasionally 3 toothed; margins horny, occasionally involute on upper surface. Leaves secund, arising at right angles to the stems, young leaves thickly villous to lanate, soon glabrous. *Inflorescences* axillary, borne at the apices of the flowering shoots, usually solitary. Inflorescence globose, 1,0—1,5 cm in diam.; pedunculate, peduncle 0,5—1,5 cm long, very thickly villous to lanate. 1,5 mm in diam. Inflorescences 12—30 flowered. *Involucral receptacle* depressed globose, 2,0 mm in diam., very much reduced. *Involucral bracts* lanceolate acuminate, 6,0 mm long, 1,5—2,0 mm broad; in a single series. *Bracteoles* lanceolate to broadly ovate, apex acuminate, somewhat cartilaginous, very thickly villous, becoming considerably enlarged (to 1,0 cm long) and woody after pollination. *Perianth* 1,6 cm long, straight. *Perianth tube* 4,0—5,0 mm long, cylindric, glabrous proximally, villous distally. *Perianth claws* slender, 0,75 mm wide, villous; all 4 perianth claws becoming equally reflexed in the subterminal region at anthesis. Perianth limbs lanceolate elliptic, 2,0 mm long, 1,0 mm broad, sparsely villous to tomentose. *Style* filiform 1,4 cm long, tapering very slightly in the subterminal region. *Pollen presenter* clavate obtuse 1,0 mm long, stigmatic groove terminal. *Hypogynous scales* subulate 0,5 mm long, hyaline.

Diagnostic Characters: L. secundifolium is unlike any other species in the genus and may readily be distinguished by the glabrous, distinctly petiolate, narrowly elliptic, obtuse leaves secundly arranged and the very small (1,0—1,5 cm in diam.) few flowered inflorescences.

Type Material: Ladismith district, Swartberg, Towerkop, steep rocky slopes below shale band. 4 000 ft., 17th Dec. 1956, *Esterhuysen* 26835 (holotype BOL, isotype NBG.)

Distribution and Ecology: As only two collections of *L. secundifolium* have ever been made, its exact range is uncertain, but according to these records the species appears to be localised on the south side of the Klein Swartberg range, between Towerkop and Seven Weeks Poort.

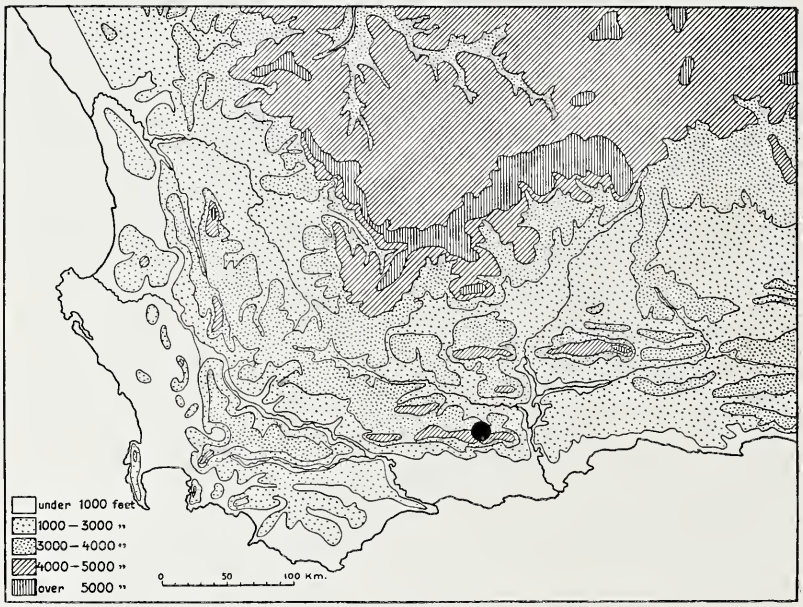


FIG. 55.
Distribution of *Leucospermum secundifolium* Rourke.

Both collections have been made at an altitude of 4 000 ft. on rocky, south facing slopes of Table Mountain Sandstone, in a region experiencing a winter rainfall of 10—15″ p.a. Flowering takes place in early December.

Specimens Examined:

CAPE

LADISMITH: Towerkop, Swartberg, steep rocky slopes below shale band, Dec., *Esterhuysen* 26835 (BOL, NBG); Seven Weeks Poort, slopes, 4,000 ft., Sept. 1928, *Pocock* s.n. (*Levyns* 2480 CT)—in fruit.

Sect. 9 CRINITAE Phillips

Sect. *Diastella* sensu Meisn, non *Diastella* (Salisb.) Endl.

Erect or sprawling shrubs. Inflorescences turbinate, 2,0—4,0 cm in diam. Involucral receptacle flat. Styles filiform, 2,5—3,0 cm long. Perianth colour varying with age, greenish-yellow to orange or crimson.

Lectotype: *L. oleifolium* (Berg.) R. Br.

Within the very natural section *Crinitae*, characterised by flat involucral receptacles and filiform styles, the prostrate species *L. gracile* and *L. saxatile* are very distinct. Likewise, erect forms having oblanceolate leaves, with 7—17 teeth at the apex, are referred to the *L. mundii* group. However, specimens having an erect growth habit, lanceolate to ovate, usually entire leaves (seldom 2, 3, 4 or 5 dentate), and membranaceous involucral bracts, belong to a complex group wherein eight different specific names have been applied in the past. It is here referred to as the *L. oleifolium* group for convenience.

(A) The *L. oleifolium* group.

After extensive field investigations it became evident that much of the variation within this group was associated with differences in the ecological conditions under which the plants were growing, particularly with regard to the elevation of the populations above sea level. It was suspected that the variation might be clinal. In order to study this phenomenon, an area near the Palmiet River mouth, between Betty's Bay and Kleinmond, was selected as the most suitable site for a transect since there is a marked altitudinal range over a short distance in undisturbed virgin veld. Three sampling stations were chosen at intervals along a 6 mile transect, covering an altitudinal range from sea level to 1 800 ft. (fig. 56).

The first station, A, at 50 ft. was situated along the coast at Sunny Seas, between De Wet's Bay and Betty's Bay, approximately 50 yards from the high water mark. The second station, B, at 500 ft. was on the lower south slopes of

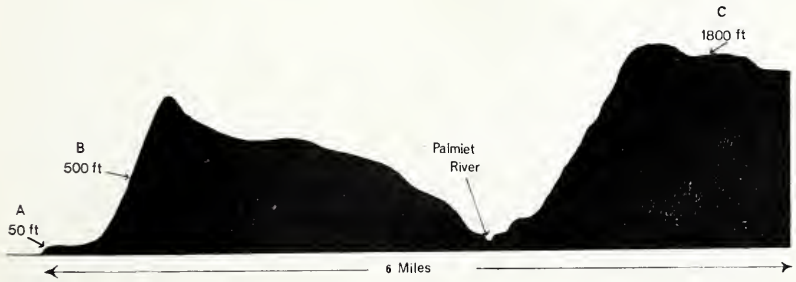


FIG. 56.

Profile of the Betty's Bay and Kleinmond mountains showing the positions of the stations along an altitudinal transect, at which the *Leucospermum oleifolium* group was sampled. Station A (50 ft.) is at Sunny Seas, between De Wet's Bay and Betty's Bay; Station B (500 ft.) is on the south slopes of Voorberg, above Sunny Seas; Station C (1 800 ft.) is on the Paardeberg plateau, above Kleinmond.

Voorberg, directly above De Wet's Bay and Sunny Seas. Similarly, station C at 1 800 ft. was situated along the Paardeberg plateau above Kleinmond. At each station 50 samples were taken at regular intervals over a distance of at least one mile on the contour line of the particular station.

Observations:

The most significant variable characters in the complex under study are growth habit, leaf pubescence and the length, form and pubescence of the involucral bracts.

The population at 50 ft. is exposed to the full force of the salt laden south easterly winds. Here, a compact rounded growth habit, with short interlocking branches, is developed. The leaves are permanently pubescent with a dense villous indumentum.

Plants at 500 ft. are characterised by a more open growth habit than the extreme maritime form at station A. Much of the pubescence on the leaves is shed at an early stage, leaving the mature leaves partly glabrous and partly pubescent.

A loose, sparsely branched, rather straggly growth habit characterises specimens from station C. The leaves are always completely glabrous.

The appearance of the inflorescence is most radically altered by differences in the length and pubescence of the involucral bracts. At each station the lengths of the involucral bracts were measured and then plotted as a series of histograms. (The bract length was measured from the innermost whorl of involucral bracts in an inflorescence.) This revealed a very distinct cline with regard to bract length which was found to increase with increasing altitude. It was found that the higher the population above sea level, the longer the involucral bracts became (fig. 57). Thus the involucral bracts of plants from the population at 1 800 ft. may be 3 or 4 times the length of those from plants at 50 ft. above sea level. Moreover, the short, acute involucral bracts of populations at an elevation of 50 ft. generally had ciliate margins, while the acuminate bracts typical of material from 1 800 ft. were found to be prominently crinite at the apex. A complete gradation of intermediate forms links the two extremes (fig.58).

Continuous variation is evident in respect of growth habit, leaf pubescence and particularly in the length and pubescence of the involucral bracts. The variation may be described as ecoclinal since it takes place along an ecological gradient ranging from an exposed rocky maritime habitat to a moist montane habitat subjected to frequent summer mists.

Seed was collected at each station during December 1964 and was planted in March 1965. In September 1969 the shrubs flowered for the first time in the author's garden. In every case they retained the characters of the wild population

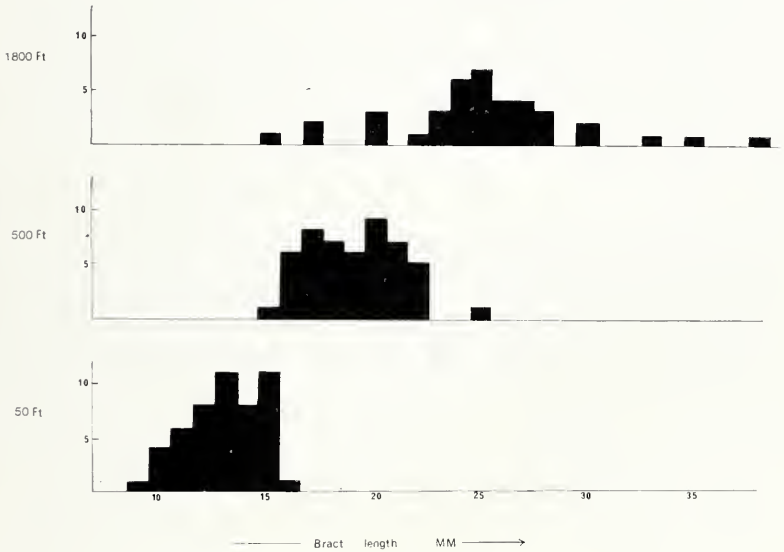


FIG. 57.
Cline in the involucral bract length of *Leucospermum oleifolium* (Berg.) R. Br. showing an increase in bract length with increasing altitude. Each of the three histograms is based on 50 samples from stations at 50, 500 and 1 800 ft. above sea level indicated in fig. 56.

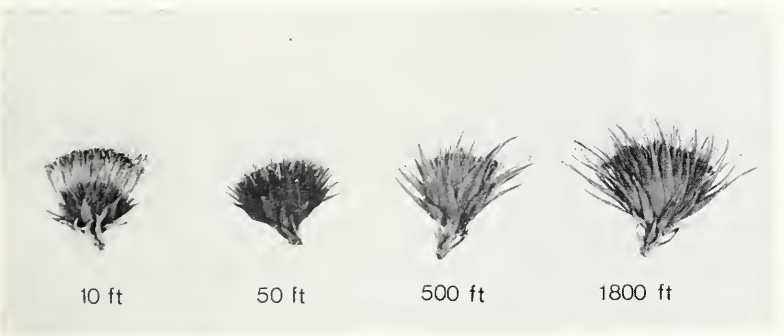


FIG. 58.
Detached inflorescences of *Leucospermum oleifolium* from populations at different elevations above sea level, showing the gradual increase in bract length with increasing altitude. ½ Life size.

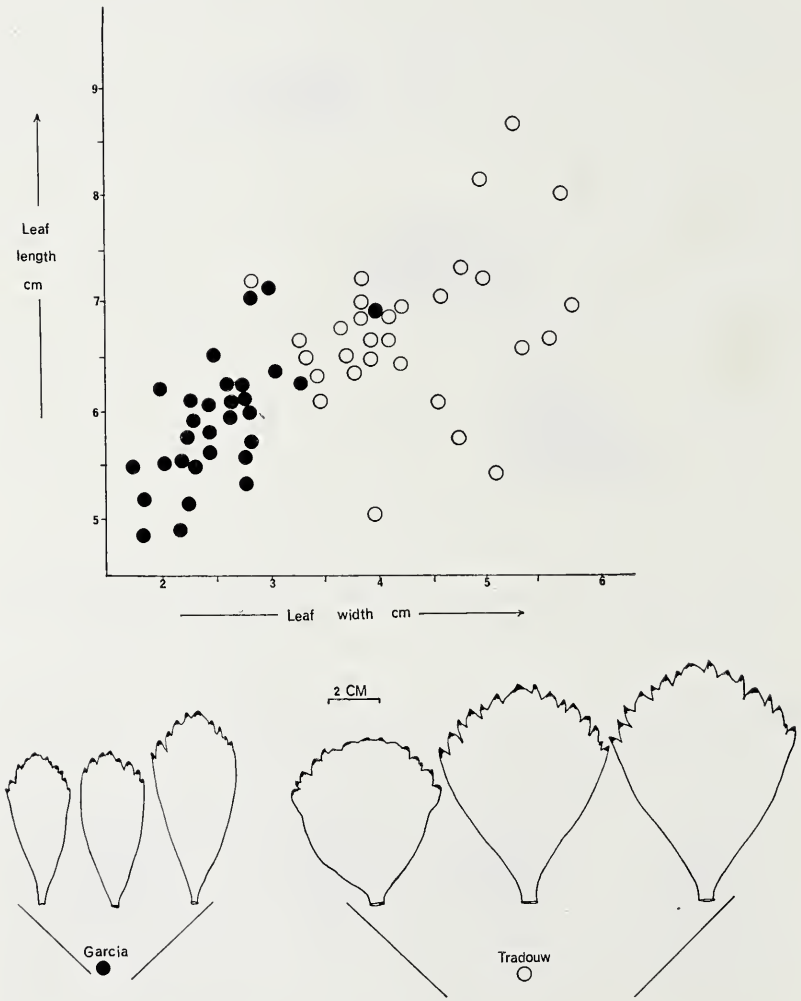


FIG. 59.
Variation in the leaf dimensions of *Leucospermum mundii* Meisn. In the scatter diagram the solid circles represent the Garcia's Pass populations with pubescent leaves and the open circles the populations from the Tradouw area, with glabrous leaves.

from which the seed was collected, clearly indicating that the various ecotypes making up the *L. oleifolium* group are genetically stabilised.

As continuous variation is exhibited within the complex described above, it is considered that only one variable species, *L. oleifolium* (Berg.) R. Br. can be recognised. Likewise, no infraspecific taxa can be clearly defined.

(B) The *L. mundii* group.

Matérial classified as *L. mundii* in herbaria appeared to be referrable to two broad groups. Firstly, a rather narrow leaved group with greyish, pubescent narrowly cuneate leaves ranging from (15) 20—35 (40) mm wide, and secondly a group with broadly cuneate to obovate, glabrous, bright green leaves, ranging from (30) 35—55 (60) mm wide. Field observations revealed that the large glabrous leaved race was restricted to the Tradouw and Barrydale mountains while the race with narrower pubescent leaves was found to be confined to the Riversdale mountains around Garcias's Pass.

Thirty samples from each population were taken and the dimensions of their leaves plotted as a scatter diagram (fig. 59). It is evident that although the foliar differences between the two populations are fairly pronounced, their variation ranges merge into each other. The presence or absence of pubescence on the leaves thus appeared to be the only absolute character by which the populations could be distinguished. Plants raised from seed collected from both populations have remained true to type in cultivation for 4 years. However, the large glabrous leaved form from Tradouw passes through a juvenile stage with pubescent leaves before the large glabrous adult leaves are produced. For these reasons, the recognition of subspecific or varietal taxa cannot be justified.

(44) **Leucospermum oleifolium** (Berg.) R. Br. in Trans. Linn. Soc. Lond. **10:** 104 (1810); Phillips & Stapf in Fl. Cap. **5:** 630 (1912).
Leucadendron oleaefolium Berg. in Kongl. Vetensk. Acad. Handl. **27:** 320 (1766); Berg., Descript. Plant. Cap.: 15 (1767). Type: Cap. b. sp., *Grubb* s.n. in herb. Bergius (SBT).
Protea crinita Thunb., Diss. Prot.: 27, 47 (1781). Type: Cap. b. spei, *Thunberg* s.n., sheet 2906 in herb. Thunberg (UPS).
Leucospermum crinitum (Thunb.) R. Br. in Trans. Linn. Soc. Lond. **10:** 103 (1810); Phillips & Stapf in Fl. Cap. **5:** 629 (1912).
Leucadendron crinitum (Thunb.) Steudel, Nomencl. Bot. ed. 2 Pars 2: 399 (1841); O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).
Protea criniflora L.f., Suppl.: 117 (1781). Type: Not traced, but based on a Thunberg specimen.

Leucadendrum criniflorum (L.f.) Salisb. ex Knight in Knight, Cult. Prot.: 58 (1809).
Protea venosa Lam., Encycl. Meth. Bot. **1:** 234 (1792). Type: Without locality or collector in herb. Lamarck (P–LA).
Leucospermum molle R. Br. in Trans. Linn. Soc. Lond. **10:** 103 (1810). Type: "Africa australis, Leucospermum molle", sheet labelled in Brown's hand (BM).
Protea mollis (R. Br.) Poir. in Lam., Encycl. Meth. Bot. Suppl. **4:** 567 (1816).
Leucadendron molle (R. Br.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).
Leucospermum penicillatum Buek in Drège, Zwei Pfl. Geog. Docum.: 85, 199 (1843),—nom. nud.
Leucospermum penicillatum Buek ex Meisn. in DC., Prodr. **14:** 260 (1856). Type: Klein Hout Hoek, *Zeyher* 3683 (NY, S).
Leucadendron penicillatum (Beuk ex Meisn.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891).
Leucospermum cryptanthum Buek in Drège, Zwei Pfl. Geog. Docum.: 82, 199 (1843),—nom. nud.
Leucospermum schinzianum Gandoger in Bull. Soc. bot. Fr. **60:** 53 (1913). Type: Cape, *Zeyher* 3684c, holotype in herb. Gandoger (LY).

An erect, rounded shrub to 1,0 m in height; with a single main stem at base; compact and rigid or loosely branched with suberect stems. *Flowering stems* 3,0—6,0 mm in diam., villous to tomentose when young, becoming glabrous later. *Leaves* lanceolate acute to oblong, or ovate obtuse, sessile, glabrous to villous, 4,0—6,0 cm long, 8,0—25,0 mm wide; entire or 2—5 toothed; margin occasionally undulate. *Inflorescences* turbinate, 2,5—4,0 cm in diam., subsessile 2—5 nate, rarely solitary. *Involucral receptacle* flat, 12,0 mm wide. *Involucral bracts* ovate acute to lanceolate acuminate, 9,0—36,0 mm long, 5,0—7,0 mm wide; densely to loosely imbricate; villous to glabrous, with or without a distinctly crinite apex; membranaceous to papyraceous in texture. *Bracteoles* very narrowly lanceolate to linear, 1,0—3,0 cm long; membranaceous, lanate proximally, pilose distally. *Perianth* 2,0 cm long, straight; hyaline to pale yellowish green, becoming crimson with age. *Perianth tube* 8,0 mm long, glabrous, tubular cylindric, inflated distally, narrowing proximally. *Perianth claws* filiform, becoming equally and strongly reflexed on opening. *Perianth limbs* elliptic 1,5 mm long, 1,0 mm wide, very sparsely tomentose to glabrous, scarcely differentiated from claws. *Style* strongly arched and cygneous when developing, elongating and straightening rapidly, 2,5—3,0 cm long, filiform; pale yellow at first becoming crimson with age. *Pollen presenter* filiform, cylindric, 1,0 mm long, slightly thickened basally; stigmatic groove terminal. *Hypogynous scales* filiform obtuse, hyaline 2,0 mm long.

Diagnostic Characters: In the section *Crinitae* characterised by a flat involucral receptacle and filiform styles, *L. oleifolium* is distinguished by its lanceolate acute to acuminate membranaceous involucral bracts and the lanceolate to ovate leaves, generally entire and rarely 2—5 toothed at the apex.

All the synonyms quoted were typified without serious difficulty except *Protea criniflora* L. f. No type material of this name has been traced either in London or Stockholm but as it was based on a Thunberg collection it is likely to have been a duplicate of the specimen on sheet 2906 in Thunberg's Herbarium.

Distribution and Ecology: The range of *L. oleifolium* extends from Cape Hangklip and Betty's Bay in the south, northwards through the Kogel Berg Reserve, Hottentots Holland, French Hoek, Villiersdorp and Stettynskloof mountains, and eastwards along the River Sonder End Range as far as Tyger Hoek. Outlying populations occur in the Bain's Kloof mountains.

The habitats occupied by this species range from rather dry rocky coastal margins 50 yards from the high water mark, to cool peaty south-facing mountain slopes at 3 000 ft. A fairly copious supply of moisture appears to be a significant factor in determining the distribution of *L. oleifolium* since its entire range falls within a zone receiving a mean annual rainfall of 30—70″. It has not been recorded from localities where the mean annual rainfall is less than 30″. *L. oleifolium* occurs exclusively on weathered Table Mountain Sandstone in association with dense sclerophyll composed mainly of Restionaceae, Ericaceae and Proteaceae. Local stands of many hundreds of individuals growing in close association are often encountered, particularly in the south but towards the eastern and northern margins of the distribution range the plants become more widely dispersed and are frequently seen as solitary specimens. Flowering takes place from August to January with a peak in September and October. On opening, the perianth and style are bright yellow but become brilliant crimson with age, in which state they persist for up to eight weeks.

Specimens Examined:

CAPE

PAARL: Bains Kloof, Nov., *Schlechter* 9095 (PRE, BOL, Z, BR, G, K, BM, S, PH); French Hoek, Oct., *Marloth* 8378 (PRE); Roadside near French Hoek, *Letty* 50 (PRE); Du Toit's Kloof, 30/9/1828, *Drège* s.n. (P); Assegaaibooskloof, Oct., *C. Banks* s.n. sub. STE 30016 (STE); French Hoek, Assegaaibos, Oct., *van Breda* 694 (PRE, BOL, G); Bain's Kloof, Oct., *Strey* s.n. (M).

STELLENBOSCH: Jonkershoek forest reserve, Nov., *Rycroft* 1434 (BOL, NBG); Hottentots Holland, Feb.—March 1827, *Verreaux* s.n. (G).

WORCESTER: Wildepaardeberg mts., top of Baviaanskloof, *Stokoe* 6568 (BOL); Omklaarberg, Dec., *Stokoe* s.n. (PRE); Stettyn's Kloof, Oct., *W. E. Powrie* s.n. (NBG); Aasvogelberg near Villiersdorp, Oct., *Marloth* 13334 (PRE).

SOMERSET WEST: Lourensford estate, Sept., *Williams* 516 (BOL); Lourensford, Oct., *Mackay* s.n. sub. SAM 23616 (SAM).

CALEDON: Genadendal, Dec., *Schlechter* 9839 (PH, BOL, BR, Z, S, G, K, BM, PRE); Hangklip near Kleinmond, Dec., *Noel* 1344 (GRA); Sir Lowry's Pass, Aug., *Parker* 4601 (PRE, NBG, K, PH); Klein Houw Hoek, Oct., *Zeyher* 3683 (NY, BOL, SAM, K, S); Appels Kraal, River Sonder End, Oct., *Zeyher* 3684 (PRE, SAM, K, NY, S); Between Palmiet River and Cape Hangklip, April, *Andreae* 891 (STE, PRE); Betty's Bay, Nov., *van Rensburg* 2156 (STE, PRE, BM); Highlands forest reserve, Aug., *Hubbard* 468 (STE); Palmiet River bridge, Oct., *van Breda* 1438 (STE, PRE); Kogelberg Reserve, Aug., *van der Merwe* 1244 (STE, PRE); Elgin, mountain slopes, Sept., *Levyns* 3370 (CT); Kleinmond, Oct., *Levyns* 7745 (CT); Palmiet River, March, *Levyns* 2661 (CT); Pringle Peak, Oct., *Esterhuysen* 23916 (BOL); Along coast at Hangklip, Jan., *Rodin* 3176 (BOL, PRE, K); Upper east slope of Hangklip, Jan., *Pillans* 8276 (BOL); Kleinmond, Sept., *Compton* 3404 (BOL, K); Houw Hoek, July, *MacOwan* 910 in Herb. Norm. Aust. Afr. (SAM, BOL, G, BM, K, BR); Hottentots Holland mts., near Sir Lowry's Pass, May, *Bolus* 5331 (BOL); Oliphants River valley, River Sonder End, June, *Williams* 754 (NBG); Betty's Bay, lower slopes of Voorberg, Oct., *Rourke* 608 (NBG); Palmiet River mouth, Nov., *Compton* 12367 (NBG); Hangklip, Sept., *Compton* 13527 (NBG); Mountains at Hangklip, Nov. 1838, *Krauss* s.n. (M); Houw Hoek, *Lichtenstein* 15 (B); Lowry's Pass, 16/12/1828, *Drège* s.n. (P); Summit of Swartberg, Caledon, Nov., *Pappe* s.n. sub. SAM 19612 (SAM); Genadendal, 28/10/1828, *Drège* s.n. (SAM, P); Platteberg, Palmiet River valley, Oct., *Stokoe* s.n. sub. SAM 65938 (SAM); Lebanon forest reserve, Sept., *Martin* 1039 and 1041 (NBG); Highlands, Aug., *Compton* 7891 (NBG); Mountain slope near Pringle Bay, Sept., *Rycroft* 1224 (NBG); Caledon, Baths, Dec., *F. Guthrie* 3587 (NBG); Voorberg near Betty's Bay, Sept., *H. C. Taylor* 1549 (NBG); Between Sunny Seas and Palmiet River, bridge, Dec., *Gill* 29 (NBG); Villiersdorp, Sept., *M. Cloete* s.n. sub. NBG 19430 (NBG); Kogelberg Peak, on N.W. slopes, Aug., *Rourke* 819 (NBG); Nuweberg forest reserve, Aug., *Rourke* 829 (NBG); Paardeberg, above Kleinmond, Nov., *Rourke* 979 (NBG); Sunny Seas, lower south slopes of mountain near Die Blomhuis, Nov., *Rourke* 994 (NBG); Sunny seas, on ridge 50 yds. from sea, Nov., *Rourke* 993 (NBG); Between Buffels River mouth and Rooi Els, Dec., *Rourke* 1004 (NBG).

WITHOUT PRECISE LOCALITY: Without collector or locality in herb. Burman (G); Cap. b. spei, *Thunberg* in herb. Swartz (S); Cap. b. spei, *Grubb* in herb. Bergius (SBT); Cap. b. spei, *Wanmanu* in herb. Bergius (SBT); Cap. b. spei, *Thunberg* s.n. sheet 2906 (UPS).

(45) **Leucospermum mundii** Meisn. in DC., Prodr. **14:** 261 (1856); Phillips and Stapf in Fl. Cap. **5:** 623 (1912). Type: In montibus prope Tradouw, Feb. 19th, *Mund* s.n. holotype (B), fragm. of holotype in herb. Meisn. (NY); isotypes (SAM, K).

Leucadendron mundtii (Meisn.) O. Kuntze, Rev. Gen. Pl. **2:** 579 (1891), err. orthog.

Leucospermum purpureum Mund ex Meisn. in DC. Prodr. **14:** 261 (1856),— nom. nud.

An erect, rounded, much branched shrub, 0,5—1,0 m in height, with a single main stem at base. *Flowering stems* 5,0—6,0 mm in diam., covered with a densely villous cinereous indumentum. *Leaves* broadly cuneate to very broadly obovate, 5,0—8,5 cm long, 2,0—6,5 cm wide, subsessile to scarcely petiolate; glabrous, or canescent with a dense indumentum of fine crisped hairs; margin incised at apex with 7—17 teeth. *Inflorescences* turbinate, 2,0—4,0 cm long, 1,0—2,0 cm wide; in clusters, 3—10 nate; pedunculate, peduncle 1,0—1,5 cm long. *Involucral receptacle* flattened, 6,0—7,0 mm wide. *Involucral bracts* lanceolate acute to

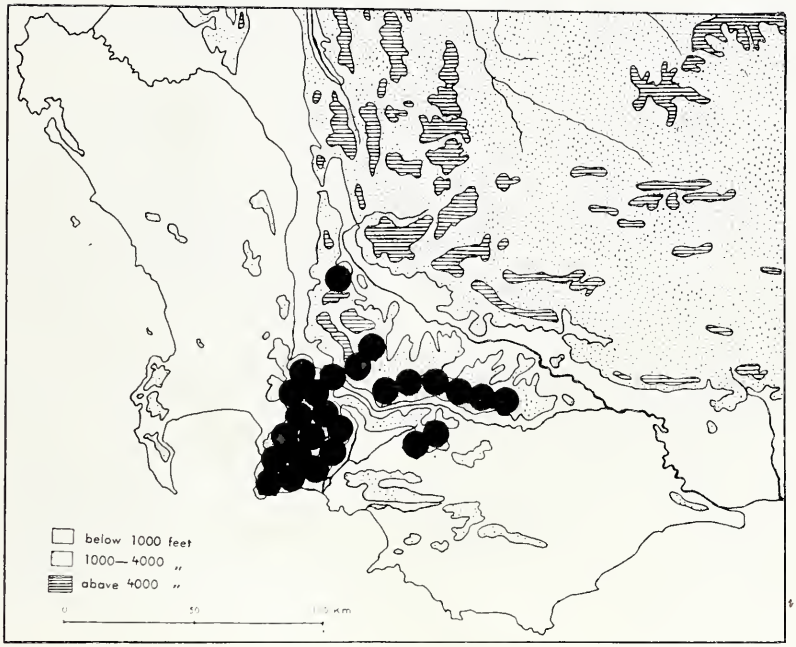


Fig. 60.
Distribution of *Leucospermum oleifolium* (Berg.) R. Br.

ovate acute, 5,0—7,0 mm long, 3,0—5,0 mm wide, imbricate, cartilaginous, densely velutinous, the apex slightly recurved and thickened. *Bracteoles* rectangular-obtrullate, 5,0 mm long, 2,0 mm wide, cartilaginous, thickly tomentose, apex recurved. *Perianth* 16,0—18,0 mm long, yellow at anthesis, tube dull carmine. *Perianth tube* 8,0—10,0 mm long, cylindric, inflated and puberulous distally, narrowed and glabrous proximally. *Perianth claws* filiform, hispidulous, equally recurved subterminally, pale yellow aging to orange. *Perianth limbs* elliptic to lanceolate acute, 1,5 mm long, pale green. *Style* filiform, straight, 2,5—2,8 cm long, pale yellow. *Pollen presenter* filiform, cylindric-obtuse, 0,5—1,0 mm long, scarcely differentiated from the style; stigmatic groove terminal. *Hypogynous scales* filiform, obtuse, 2,0—2,5 mm long, hyaline.

Diagnostic Characters: The cuneate to very broadly obovate leaves, 7—17 toothed at the apex, distinguish *L. mundii* from all other species in the section *Crinitae*.

Leopold Mund made the original collection of this species in the mountains near Tradouw on Feb. 19th (no year given), according to his field notes on the type in Berlin (B). The fact that the inflorescences were old and faded when collected probably explains why Mund proposed the manuscript name, *L. purpureum* for this species. Since only this collection was cited by Meisner and is annotated in his handwriting, it may be regarded as the holotype. A few leaves and perianths in a capsule in Meisner's personal herbarium (NY), were evidently removed from the main sheet in Berlin by Meisner.

Distribution and Ecology: L. mundii is confined to the Langeberg range where it has been recorded from a few localities only, between Goedgeloof Peak, Swellendam and Garcia's Pass, Riversdale.

This species appears to be restricted to the northern slopes of cool, south west facing kloofs at elevations of 1 000—3 000 ft. Although a mean annual rainfall of 25—40″ is experienced, well drained slopes on Table Mountain Sandstone are preferred. The small, very local populations usually grow in association with dense fynbos, consisting mainly of Restionaceae, *Leucadendron eucalyptifolium*, *Protea eximia* and *P. neriifolia*. Flowering takes place from July to November.

Specimens Examined:

CAPE

SWELLENDAM: Goedgeloof Peak, north slopes of Langeberg, Sept., *Esterhuysen* 24512 (BOL); Barrydale mountains, Oct., *Barnard* s.n. sub. SAM 29023 & 28973 (SAM).

HEIDELBERG: Mountains round Tradouw Pass, Oct., *Adamson* s.n. sub. SAM 39006 (SAM); In the mountains near Tradouw, Feb., *Mund* s.n. (B, NY, K, SAM); Tradouw Pass, Oct., *Neethling* s.n. sub. STE 19371 (STE); Tradouw Pass, slopes with south aspect, Sept., *Esterhuysen* 24609a (BOL); Tradouw Pass, Sept., *Williams* 514 (BOL); Oct., *Levyns* 657 (CT); Along mountain slopes at Tradouw Pass, *van Breda* 2154 (PRE, K); Lower slopes of Tradouw Peak, Sept., *Rourke* 854 (NBG).

RIVERSDALE: Garcia's Pass, mountain slopes, Sept., *Muir* 517 (SAM); Garcia's Pass, Sept., *Compton* 7544 (NBG); Oct., *Marloth* 8855 (PRE, STE); July, *Acocks* 15424 (PRE, K); Oct., *Pillans* 2900 (PRE); Mozambique Kop, south slopes, Oct., *Thorne* s.n. sub. SAM 38941 (SAM); Top of Garcia's Pass, Oct., *Hubbard* 225 (STE); Garcia's Pass, Sept., *Phillips* 517 (PRE, K); In declivibus saxosis Garcia's Pass, *Bolus* 11366 (BOL, PRE, NH, K); Garcia's Pass, Oct., *Galpin* 4478 (PRE, K); Langeberg, Riversdale, Sept., *Muir* 1117 (PRE); Riversdale, Feb., *Marloth* 3597 (PRE); Near Crystal Pool, Garcia's Pass, *Williams* 539 (BOL, NBG); Garcia's Pass, June, *van Breda* 1097 (PRE, K); Crystal Kloof, north slopes of Kampscheberg, Oct., *Rourke* 623 (NBG).

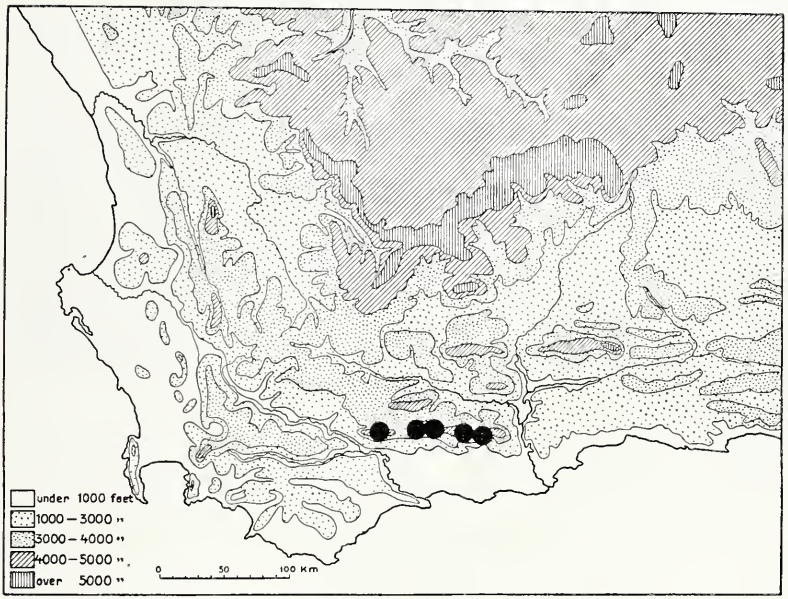


FIG. 61.
Distribution of *Leucospermum mundii* Meisn.

(46) **Leucospermum gracile** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **33:** 226 (1967).
Leucadendrum gracile Salisb. ex Knight in Knight, Cult. Prot.: 59 (1809). Type: "On the mountains near Klein River", *Niven* (not traced). Neotype: Lower slopes of Klein River mts., at Fernkloof, Hermanus, Sept., *Rourke* 852 (NBG).
Leucospermum stenanthum Schlechter in Bot. Jb. **27:** 112 (1900); Phillips in Fl. Cap. **5:** 632 (1912). Type: In montibus pone Bot River, *Schlechter* 9446 (Holotype B; isotypes BOL, BM, PRE, K, Z, G, S, BR).

A low sprawling shrub, 30,0—40,0 cm in height, with a single main stem at base, forming rather diffuse mats to 1,5 m in diam., *Flowering stems* slender, 2,0—3,0 mm in diam., villous to glabrescent; trailing along ground. *Leaves* oblong linear, obtuse, entire or trifid, obtuse to truncate at base, 2,0—4.5 cm long, 2,0—5,0 mm wide; usually widely spaced and secund, occasionally loosely ascending; sparsely villous to puberulous. *Inflorescences* turbinate, 2,5—3,0 cm

in diam.; sessile to pedunculate, peduncle up to 2,0 cm long, usually at right angles to stem. *Involucral receptacle* flat, 0,5 cm wide. *Involucral bracts* very narrowly lanceolate linear 0,8—1,0 cm long, 1,0—1,5 mm wide; apex acuminate to slightly cirrhous and minutely crinite; imbricate, cartilaginous, tomentose. *Bracteoles* oblanceolate, abruptly acute or acuminate, 5,0—6,0 mm long, 1,5 mm wide, cartilaginous, very thickly lanate. *Perianth* 2,0—2,5 cm long, yellow, becoming greenish in the tube region. *Perianth tube* 8,0 mm long, tubular obconical, glabrous, but minutely puberulous distally. *Perianth claws* filiform, becoming sharply recurved subterminally, adaxial claw glabrous to glabrescent proximally, the remainder hispidulous. *Perianth limbs* narrowly lanceolate acute, 1,0 mm long, scarcely differentiated from the perianth claws. *Style* filiform, 2,5—3,0 mm long, straight, tapering towards apex; yellow, becoming pale green with age. *Pollen presenter* 1,0 mm long, cylindric acute, scarcely differentiated from style, stigmatic groove terminal. *Hypogynous scales* clavate, hyaline 3,0 mm long.

Diagnostic Characters: *L. gracile* is distinguished from related species by its prostrate growth habit, the oblong-linear leaves (not exceeding 5,0 mm in width), truncate at the base, the abruptly acute oblanceolate bracteoles and the yellow perianth.

The earliest collections of this species were made by Masson and Niven. Niven noted that he had found *L. gracile* "on the mountains near Klein River, in great abundance". Unfortunately, no type material of this collection has been traced but Knight's description is so detailed that it can only refer to *L. gracile*. Material answering to the original description has been gathered by the present author in the Klein River mountains where this species is still abundant today. It is proposed that this collection (*Rourke* 852) serve as the neotype until material from the original Niven collection comes to light.

Distribution and Ecology: Schlechter's collection from the mountains near Bot River is the most northerly record for *L. gracile* but it has probably been exterminated here due to agricultural development. It is nevertheless fairly frequent on Shaw's Mountain near Caledon and on the Onrust and Klein River mountains near Hermanus, extending southwards to the hills around Napier.

L. gracile occurs on south facing mountain slopes between 300 and 1 000 ft. elevations, occasionally reaching 3 000 ft. Always in very well drained situations, this species shows a marked preference for well drained sandy soils on rocky slopes where the surface layers of Table Mountain Sandstone are weathering and crumbling. Mature plants grow into diffuse mats up to 1,5 m in diam. from the perimeter of which develop trailing shoots bearing yellow inflorescences. Occasionally inflorescences are developed from the more rigid short shoots near the centre of the plant. Flowering takes place from July to December.

Specimens Examined:

CAPE

CALEDON: In montibus pone Bot River, Nov., *Schlechter* 9446 (B, BOL, BR, Z, G, S, BM, K, PRE); Shaw's Mountain, *Bodkin* 9230 (BOL); Klein River mountains between Stanford and Hermanus, Aug., *Stokoe* 16611 (BOL); Klein River mts., S.E. slopes, Sept., *Esterhuysen* 2889 (BOL); Mountains behind Mossel River, Oct., *Martin* 552 (NBG, BOL); Onrust, Sept., *Compton* 3402 (BOL, K); Voelklip, Sept., *Basson* s.n. (STE 16836); Onrust River mts., summit, S.E. side, Nov., *Esterhuysen* 4258; Mossel River, Nov., *Maguire* 1273 (NBG); Near Shaw's Pass, *Gill* 44 (NBG); Voelklip, Sept., *Barker* 1707 (NBG, PRE); Klein River mountains behind Voelklip, July, *Williams* 797 (NBG); Klein River mts., east of Rocklands peak, Sept., *Stokoe* s.n. (SAM 56587, PRE); Stanford mts., July, *Stokoe* no. 9501 in herb. Marloth (PRE); Slopes of Babylon's Tower between Hermanus and Caledon, March, *Zinn* s.n. (SAM 53682); Lower slopes of the Klein River Mountains, Fernkloof, Hermanus, Sept., *Rourke* 852 (NBG).

BREDASDORP: Sanddrif, Napier, Oct., *van Breda* 1427 (STE, PRE); Fairfield, Sept., *Thomas* s.n. (NBG 42557); Sondags Kloof near Napier, Oct., *Williams* 47 (NBG).

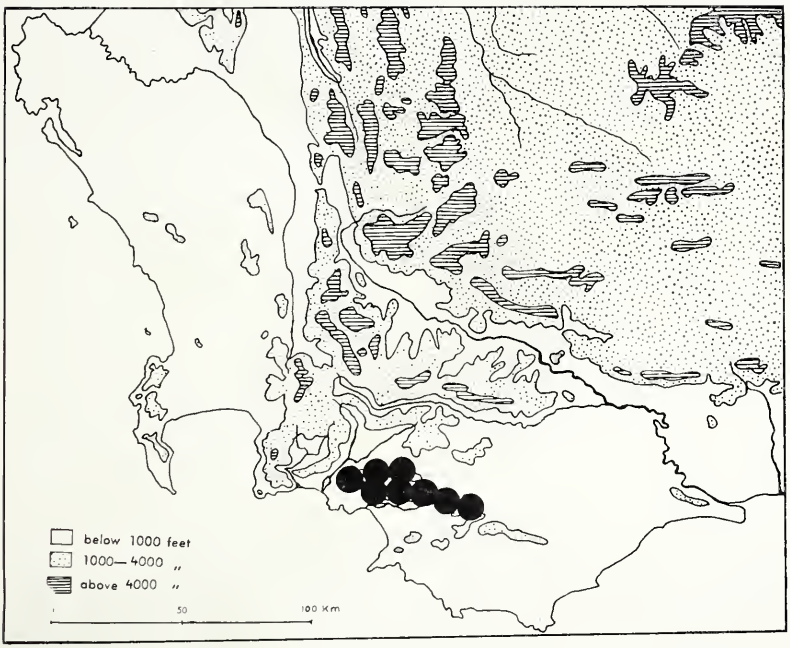


FIG. 62.
Distribution of *Leucospermum gracile* (Salisb. ex Knight) Rourke.

(47) **Leucospermum saxatile** (Salisb. ex Knight) Rourke in Jl S. Afr. Bot. **33:** 266 (1967).

Leucadendrum saxatile Salisb. ex Knight in Knight, Cult. Prot.: 58 (1809). Type: "On dry rocks near Groot Rivier" *Niven* (not traced). Neotype: Foothills of the north slopes of the Langeberg, at the farm Waterval, 13th, Jan. 1965, *Rourke* 248 (NBG).

Leucospermum diffusum R. Br. in Trans Linn. Soc. Lond. **10:** 104 (1810); Phillips in Fl. Cap. **5:** 631 (1912), excluding citations of *L. pedunculatum* Klotzsch. Type: Africa australis, *W. Roxburgh* s.n. (BM).

A low, suberect to sprawling shrub 0,5—0,7 m in height; 1,0—1,5 m in diam. *Stems* suberect to trailing, 2,—4,0 mm in diam., sparsely pubescent, soon becoming glabrous, reddish tinted. *Leaves* loosely ascending, very rarely subsecund, linear to very narrowly cuneate, narrowing to the base, 2,5—5,0 cm long, 2,0—5,0 mm wide, puberulous at first, soon glabrous: apex usually entire, occasionally with 2—3 teeth; margins frequently involute. *Inflorescences* turbinate, 2,5—3,0 cm in diam., usually single, occasionally 2—3 nate; pedunculate, peduncle 0,5—1,5 cm long. *Involucral receptacle* flat, 0,7 cm in diam. *Involucral bracts* lanceolate acute-acuminate, 4-seriate, imbricate, cartilaginous, tomentose, 0,5—1,0 cm long, 2,0 mm wide. *Bracteoles* lanceolate acute-acuminate, 1,2—1,5 cm long, 2,0—2,5 mm wide, densely sericeous, margins ciliate. *Perianth* 2,0 cm long, pale lime green on opening becoming carmine tinted with age. *Perianth tube* 5,0—6,0 mm long, tubular obconical, glabrous. *Perianth claws* straight, filiform, sericeous, sharply recurved subterminally. *Perianth limbs* narrowly lanceolate linear, 2,0 mm long, sericeous. *Style* filiform, 3,0 cm long, tapering subterminally. *Pollen presenter* cylindric-obtuse, 1,0 mm long, scarcely differentiated from style. *Hypogynous scales* subulate, hyaline, 1,0 mm long.

Diagnostic Characters: The narrowly cuneate to linear leaves, narrowed towards the base, often with involute margins, the lanceolate acute bracteoles and the pale green colour of the perianth distinguish *L. saxatile* from related species.

Knight's type of *L. saxatile* has not been traced, despite a careful search in European and American herbaria. This leads one to conclude that it has either been lost or destroyed. Nevertheless, his description of this species albeit brief, provides details of the growth habit, morphology and dimensions of the leaves and the structure of the style. The locality is given as "dry rocks near Groot Rivier". The Groot River joins the Gouritz River in the Little Karroo and runs parallel to the northern foothills of the Langeberg. A collection made by the

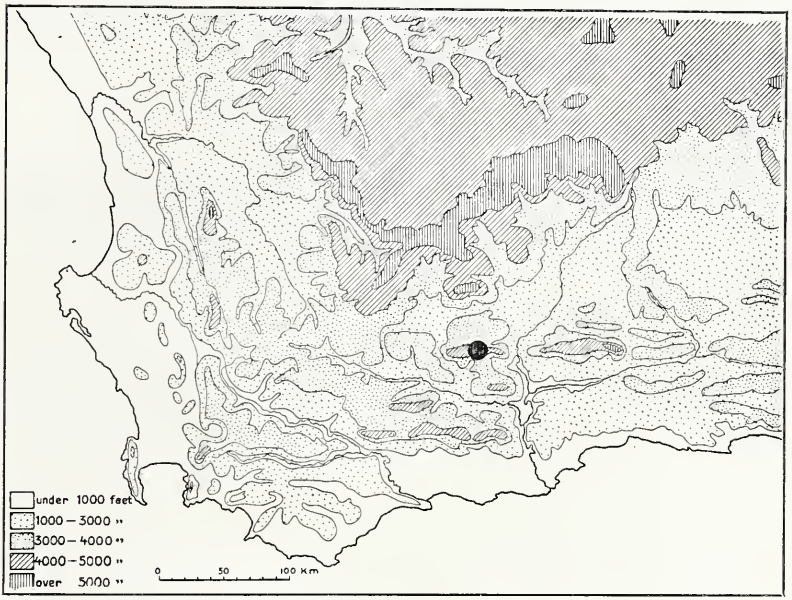


FIG. 63.
Distribution of *Leucospermum saxatile* (Salisb. ex Knight) Rourke.

present author at this locality on the farm "Waterval" matches Knight's description in all the details. It is therefore proposed that this collection serve as the neotype of *L. saxatile* until the original material is traced.

Distribution and Ecology: This very localised species is restricted to a narrow zone of Arid Fynbos which skirts the north slopes of the Langeberg in the Riversdale district, adjacent to and just fringing the Rhenosterveld of the Little Karroo. According to herbarium records and the author's own field observations, the present known distribution range extends from Muiskraal eastwards to Rietvlei, a distance of about 20 miles.

The altitudinal range is very small, being from 1 500—2 000 ft. At the farm "Waterval", *L. saxatile* is locally common with the plants forming quite dense stands, either sprawling on rocky sandstone slopes or scrambling over low shrubs. *L. saxatile* forms a suberect to decumbent shrub 1,0—1,5 m in diam., with long trailing branches occasionally being produced. Flowering commences in July and continues until February. The pale lime green perianths and styles

which become carmine tinted with age are a very distinctive feature of *L. saxatile*.

Specimens Examined:

CAPE

RIVERSDALE: Muiskraal, 1,000 ft., Oct., *Galpin* 4456 (PRE, K); Waterval on the Muiskraal—Gouritz road, dry slopes, July, *Levyns* 11280 (CT); North side of the Langeberg above Waterval, Oct., *Muir* 2783 (PRE, BOL); Rietvlei, beyond Waterval, Sept., *Williams* 1055 (NBG); Behind the Langebergen, Riversdale, Sept., *Dekenah* s.n. sub. 87489 in NBG (NBG); Foothills of the northern slopes of the Langeberg at the farm Waterval, Jan., *Rourke* 248 (NBG).

WITHOUT PRECISE LOCALITY: Africa australis, *W. Roxburgh* (BM, G).

SPECIES NON SATIS COGNITAE

(1) *Leucadendron filamentosum* Burm. f., Prodr. Fl. Cap.: 4 (1768). No type could be traced in Burman's herbarium (G). The description could apply to several species of *Leucospermum*.

(2) *Leucadendron polifolium* Burm. f., Prodr. Fl. Cap.: 4 (1768). No type could be traced in Burman's herbarium (G). The description could apply to several species of *Leucospermum*.

(3) *Leucadendrum bellidifolium* Salisb. ex Knight in Knight, Cult. Prot.: 56 (1809); Phillips & Stapf in Fl. Cap. **5:** 638 (1912). No type has been found and the description could apply to several species of *Leucospermum*.

SPECIES EXCLUDED

(1) *Leucospermum glaberrimum* Schlechter in Bot. Jb. **27:** 111 (1900).
This is *Leucadendron glaberrimum* (Schlechter) Compton in Trans. R. Soc. S. Afr. **19:** 279 (1931).

(2) *Leucospermum involucratum* (Lichtenstein ex Roem. & Schult.) Steud., Nomencl. Bot. ed I **2:** 477 (1824).
Protea involucrata Lichtenstein ex Roem. & Schult. in Roem. & Schult., Syst. Veg. **3:** 363 (1818).
This is *Leucadendron salignum* Berg.

(3) *Leucospermum marginatum* (Willd.) Spreng., Syst. Veg. **1:** 464 (1825); Roem. & Schult., Mant. Syst. Veg. **3:** 266 (1827).
Protea marginata Willd., Enum., Hort. Berol. suppl.: 7 (1814). Type: Sheet no. 2450 in herb. Willdenow (B), photo. (NBG).
Leucadendron marginatum (Willd.) Link, Enum. Hort. Berol. Altera **1:** 115 (1821).
This is *Leucadendron spissifolium* (Salisb. ex Knight) Williams.

(4) *Leucospermum obovatum* Marloth, Fl. of S. Af. **1:** 151 (1913)—nom. nud.

(5) *Leucospermum ovatum* (Thunb.) Roem. & Schult., Mant. Syst. Veg. **3:** 266 (1827).
Protea ovata Thunb. in Mem. Acad. Imp. Sci. St. Petersbourg Hist. Acad. **14:** 548, t. 17 (1813). Type: E. cap. b. spei, *Sparman* s.n., sheet 2948 in herb. Thunberg (UPS).
This is *Protea longiflora* Lam.

(6) *Leucospermum rochetianum* A. Rich. in Compt. Rend. Par. **1:** 229 (1851).
This is *Faurea rochetiana* (A. Rich.) Chiov. ex Pichi Sermoli in Webbia **7:** 327 (1950).

(7) *Leucospermum spathulatum* Drège ex Meisn. in DC., Prodr. **14:** 299 (1856), non R. Br. (1810).
This is *Paranomus reflexus* (Phillips & Hutchinson) N.E. Br.

(8) *Leucospermum zwartbergense* Bolus in Trans. S. Afr. phil. Soc. **18:** 399 (1909). Type: Swartberg Pass, *Bolus* 12267 (BOL).
This is a male specimen of *Leucadendron dregei* E. Mey. ex Meisn.

Putative Hybrids

A number of putative interspecific hybrids have been recorded. Whenever hybrids have been observed in the field, their identity is usually quite obvious due to the close association of the parents. In such cases only one or two hybrid plants are ever encountered, suggesting that these hybrids are sterile. Putative hybrids observed in gardens are also listed.

(1) *L. hypophyllocarpodendrom* × *L. pedunculatun.*
Klein Hagel Kraal above Pearly beach, Bredasdorp, Aug., *Rourke* 1087 (NBG).

(2) *L. hypophyllocarpodendron* × *L. calligerum.*
Mountain behind Aurora, Piketberg, Aug., *Rourke* 1061 (NBG).

(3) *L. truncatulum* × *L. prostratum.*
Elands Kloof mts., above Papies Vlei, Bredasdorp, Sept., *Rourke* 564 (NBG); Highlands, Elgin, Caledon, Nov., *Middlemost* 1932 (NBG).

(4) *L. mundii* × *L. calligerum.*
Riversdale wild flower show, *Schelpe* s.n. (NBG 86306); Mountains in Riversdale area, Oct., *Pretorius* s.n. (NBG); Riversdale, July, *Muir* 464 (PRE).

(5) *L. reflexum* × *L. catherinae.*
Ex hort. *Rourke* s.n. (NBG 86074). Kirstenbosch.

(6) *L. conocarpodendron* × *L. cordifolium.*
Ex hort. NBG, June, without collector, (NBG). This hybrid is very frequent at Kirstenbosch.

(7) *L. gracile* × *L. truncatulum*.
Onrust River mts., Caledon, Nov., *Esterhuysen* 4260 (BOL).

(8) *L. gueinzii* × *L. lineare*.
Upper end of Bosch Kloof, Jonkershoek, Jan., *Wicht* 649 (BOL).

(9) *L. tottum* × *L. vestitum*.
L. tottum (L.) R. Br. var. *glabrum* Phillips in Flower. Pl. S. Afr. **2**: t. 74 (1922). Type: In Jan du Toits Kloof, Chavonnesberg, Oct., 1921, *Stokoe* s.n. sub PRE 1493 (PRE).

No further material of this variety has ever been collected. As its characters are intermediate between *L. tottum* and *L. vestitum* it is suggested that *L. tottum* var. *glabrum* is a hybrid between these species.

Cytology

Methods

Seeds obtained from numbered collections made by the present author and deposited at NBG as voucher specimens were germinated after four to six weeks. Root tips were taken from these seedlings and fixed between 1 and 3 p.m. on warm afternoons in a Chromo-acetic-formalin mixture (Randolf, 1935). After remaining in the fixative for about 48 hours they were transferred to 70% ethyl alcohol for storage. Later, they were dehydrated through a graded butanol-ethanol series and embedded in paraffin wax. Transverse serial sections were cut at about 12μ. After having been passed through the usual series of alcohols, the sections were hydrolysed for 15 minutes in N HCl at 60°C; then washed in water and stained for about 2 hours in Feulgen reagent, prepared according to Kasten and Burton (1959).

Results

The large rectangular cells of the protoderm were found to contain the most easily observable and most numerous mitoses at metaphase. The chromosomes were found to be small in all cases (1—3μ). Consequently, difficulty was sometimes experienced in determining the position of the centromere, which may be median or subterminal. The most significant observation made was that the karyotypes of two vicarious species, *L. formosum* and *L. catherinae*, were found to possess a large pair of chromosomes bearing prominent satellites. Satellites were also observed in *L. cuneiforme* (fig. 64).

Discussion

Prior to the present studies, a chromosome number of 2n=24 had been established in four species of *Leucospermum* (de Vos, 1943). This number was confirmed by Ramsay (1963) and was found to be the same in 13 additional species counted by the present author (Table 1). The same number was found in several other genera of the Proteaceae in South Africa, namely *Paranomus*, *Serruria*, *Mimetes* and *Protea* (de Vos, 1943; Horn, 1962).

It would seem that little information of any taxonomic value can be gained from any further cytological studies on *Leucospermum* unless detailed chromosome idiograms of vicarious taxa or local races can be compared. Owing to the small size of the chromosomes this would be a technically difficult and a time consuming procedure.

Species	Authority and Voucher specimen	2 n
L. conocarpodendron	de Vos (1943)	24
L. cordifolium	de Vos (1943) as *L. nutans*	24
L. reflexum	de Vos (1943)	24
L. cuneiforme	Rourke 279	24
	de Vos (1943) as *L. attenuatum*	24
L. innovans	Rourke 841	24
L. lineare	Rourke 57	24
L. pluridens	Rourke 621	24
L. glabrum	ex hort. (NBG 84811)	24
L. tottum	Rourke 56	24
L. formosum	Rourke 620	24
L. catherinae	Rourke 679	24
L. gueinzii	Rourke 831	24
L. muirii	Rourke 10	24
L. arenarium	Rourke 1080	24
L. truncatulum	Rourke 941	24
L. pedunculatum	Rourke 942	24

Table 1. Chromosome numbers in *Leucospermum*

Biology

The Effect Of Fire On Species Of Leucospermum

Fire has probably played a more significant role in the development of different life forms in the vegetation of Southern Africa than is generally acknowledged. It is hardly an exaggeration to say that fire resistance is one of the most important biological attributes any plant species occurring in Southern Africa can possess. The effect of fire on different species of Leucospermum is discussed below.

Species killed by Fire

In the majority of species of *Leucospermum*, the adult plant is killed outright by a veld fire. These species have a single main stem with a rather thin covering of bark. In a stand of mature plants eight or ten years old, in undisturbed vegetation, all the individuals in the stand are apparently the same age and size. Seedlings or young plants up to two years of age are either rare or completely absent. When such a stand is burnt, however, a dense growth of seedlings is observed the following year. These seedlings will reach the flowering stage in their third or fourth year and may continue to produce seeds annually for many years. Few, if any, of these seeds appear to germinate until the stand is again burnt, after which large numbers of seeds again germinate simultaneously. This cyclical pattern is very noticeable in members of the Proteaceae with hard nut-like fruits.

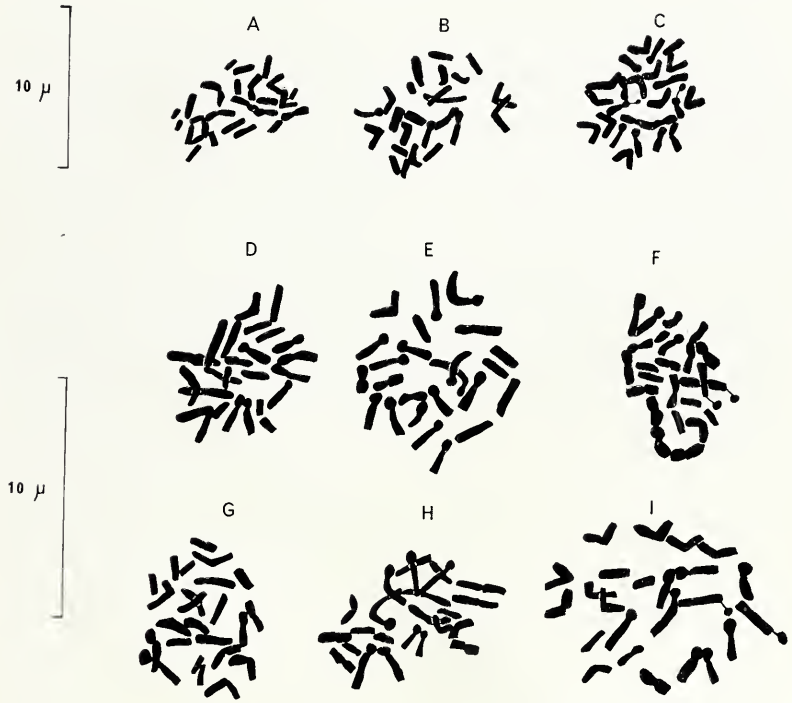


FIG. 64.
Karyotypes in *Leucospermum*. (A) *L. innovans;* (B) *L. pedunculatum*; (C) *L. cuneiforme;* (D) *L. arenarium;* (E) *L. truncatulum;* (F) *L. formosum;* (G) *L. lineare;* (H) *L. tottum;* (I) *L. catherinae*.

In all these forms the adult plant reaches a stage of senescence after a certain number of years. This time interval varies from species to species. *L. oleifolium* and *L. truncatulum* become senescent after about 25—30 years but large species like *L. conocarpodendron* and *L. praemorsum* become senescent in 50 to 80 years. These estimates have been made by counting the annual growth increments on the stems. At this stage, a fire is actually necessary to rejuvenate the population. However, biennial or even triennial veld burning such as now frequently occurs in parts of the south western Cape, usually results in the extermination of these species.

Fire-resistant Species

The thirteen species that are able to resist burning may be roughly grouped into two categories according to their degree of fire resistance (Table 2). In the first group, regeneration takes place from the stems and only 30—50% of the individuals in a population will recover after a fire (fig. 65, B and C). In the second group 95—100% of the individuals in a population will recover after a fire. In these species regeneration takes place from a subterranean rootstock or lignotuber (fig. 65, A).

L. heterophyllum, *L. royenifolium*, *L. pedunculatum* and *L. profugum* have a procumbent growth habit with a short main stem from which horizontally spreading branches arise, covered with bark, 3—6 mm thick. The peripheral branches in these species are completely destroyed by fire, leaving only the main stem and the stumps of the horizontally spreading branches. Dormant axillary buds beneath the bark are able to sprout and form new stems in many cases (fig. 65, B).

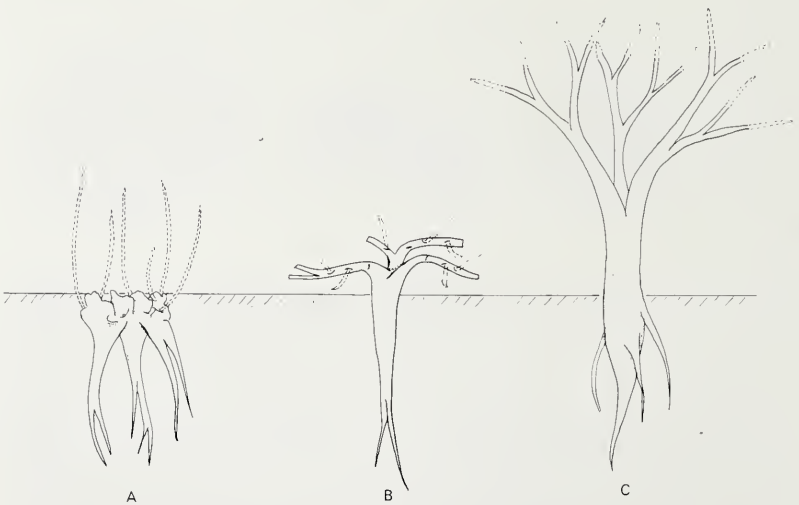


FIG. 65.
Stylized diagrams of the growth forms in *Leucospermum* in which regeneration of the vegetative parts takes place after burning. The new growth is indicated with broken lines. (A) The subterranean rootstock or lignotuber; (B) the form with a short main stem and stout, horizontally spreading branches in which regeneration takes place from axillary buds; (C) the arborescen form in which regeneration takes place from the apical shoots.

L. conocarpodendron and *L. patersonii* both develop into large shrubs or small trees. In *L. conocarpodendron* the main trunk is covered by tough bark, 3—5 cm thick. The lowermost branches of both species are destroyed by fire, which causes the adult shrubs that have been frequently burnt to develop an umbrella-shaped growth habit. Regeneration in these cases take place from the apical shoots of the uppermost branches, which by reason of their elevation above ground level are less severely burnt (fig. 65, C). Regeneration in the species discussed above (Table 2, B & C) takes place from the aerial stems. The extent to which a population will recover after burning appears to be dependent on the intensity of the fire.

A woody, subterranean rootstock or lignotuber from which numerous coppice shoots develop after burning, is considered by many to be a particularly characteristic morphological feature of much of the savannah vegetation in Africa (Bews, 1922; Burtt Davy, 1922; Henkel, 1928; Phillips, 1930; Phillips, 1968). The persistent rootstock is undoubtedly one of the most effective adaptations to surviving repeated burning (fig. 65, A). Seven species of *Leucospermum* have a persistent rootstock but it is best developed in the four species of the section *Crassicaudex* which occur mainly in the summer rainfall regions of Southern Africa. Even the seedlings of these species with multiple stems are distinguishable from the seedlings of species with a single main stem. At eight months after germination, shoots have developed in the axils of the lowermost leaves of the seedling, including the cotyledons, while a thickening of the basal part of the stem takes place at the same time. Axillary shoots do not develop on seedlings of species having a single main stem (fig. 66). From six to eight weeks after the aerial stems of the adult plant have been destroyed, new shoots will develop from the rootstock. In most cases 95—100% of the individuals in a population survive burning, irrespective of the intensity of the fire or the frequency of the burning cycles.

Stem regeneration 30—50% recovery (fig. 65, B & C)	Rootstock regeneration 95—100% recovery (fig. 65, A)
L. heterophyllum	*L. saxosum*
L. royenifolium	*L. cuneiforme*
L. pedunculatum	*L. gerrardii*
L. profugum	*L. innovans*
L. conocarpodendron	*L. hypophyllocarpodendron*
L. patersonii	*L. tomentosum*
	L. prostratum

Table 2. The fire-resistant species of *Leucospermum*, indicating the percentage recovery in a population after burning.

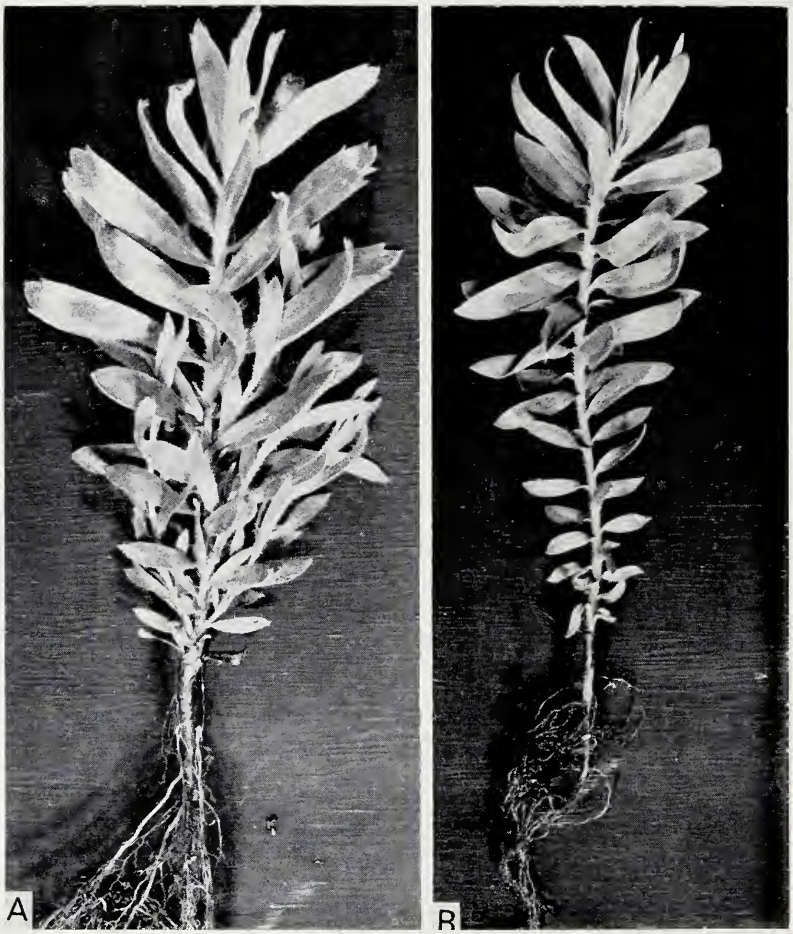


FIG. 66.

Leucospermum seedlings, 8 months after germination. Left, *L. cuneiforme* (*Rourke* 251) showing the development of shoots in the axils of the lowermost leaves, including the cotyledons. This species is taken as an example of the species of *Leucospermum* which develop a lignotuber. Right, *L. formosum* (*Rourke* 620) taken as an example of a species killed outright by fire and in which there is no development of shoots in the axils of the lowermost leaves in the seedling stage. Life size.

Pollination

Introduction

Probably the earliest recorded observations concerning pollination biology in *Leucospermum* were made by Francis Masson but it was not until 1920 that these notes were published. The first published observations however, were those of Scott-Elliot (1889) and later Marloth (1901, 1908). Apart from these studies, no further original observations have been recorded except for the brief notes of Vogel (1954) and Faegri (1965). Masson's notes are of particular interest for they establish, even at that early date, the importance of *Promerops cafer* and *Anthobaphes violacea* in the pollination biology of *Leucospermum*. Referring to *L. conocarpodendron* at Constantia, Masson notes that: "In the time of flowering the trees are plentifully stocked with birds; viz. *Certhia formosa violacea* and a brown sort with a remarkable long tail, where they feed on the nectar of the flowers which they extract with their long arched bills" (from Karsten, 1960).

The birds mentioned are *Anthobaphes violacea* and *Promerops cafer* respectively.

The Inflorescence

Using the terminology of Faegri and van der Pijl (1966), the inflorescence in *Leucospermum* may be described as the "brush type". At anthesis, the elongating styles burst free of the perianth segments while at the same time the anthers discharge pollen onto the pollen presenters. When fully expanded, the styles project well beyond the level of the coiled perianth segments, bearing the pollen presenters covered with pollen.

Nectar, produced in copious quantities, appears to be the chief attractant. The fairly viscous nectar exudes from the apices of the hypogynous scales filling the perianth tube and even welling up to form a droplet at the mouth of the perianth tube. Numerous small insects which apparently play no direct role in pollen transfer but are attracted by the nectar, serve as an added attractant to bird pollinators which are also known to be insectivorous (Broekhuysen, 1963).

The flowers in *Leucospermum* are protandrous and it has been proved by controlled pollination experiments that most but not all the species are self incompatible (Horn, 1962). Similar experiments by the author have confirmed that only a few species are self compatible (e.g. *L. mundii*, *L. oleifolium*) but even these produce only a few viable seeds after selfing. This would result in cross pollination between individuals taking place in the majority of species in the genus.

Bird Pollinators

Observations made in the south western Cape, between Van Rhynsdorp and Port Elizabeth have shown that *Promerops cafer* (L.) (the Cape Sugarbird), is the most ubiquitous pollinating agent in *Leucospermum* populations. On numerous occasions as many as 12 birds of this species have been counted feeding on the inflorescences of a single shrub. The life history of *Promerops cafer* is very closely associated with the family Proteaceae; nesting and the rearing of young taking place during the peak of the flowering season. An indication of its dominance in the above mentioned areas can be seen from the fact that Winterbottom (1966) recorded this species in 84% of the regional check lists of birds inhabiting the vegetation of the south western Cape, including non Proteaceous plant communities. In all the populations of *Leucospermum* studied in the south western Cape, *Promerops cafer* was present.

When actively feeding, it perches on the inflorescence, thrusting the head and bill through the styles to the perianth tube. Pollen is then transferred from the pollen presenters to an area on the forehead, between the eyes. The accumulation of pollen on the forehead becomes so great that it can be seen as a distinct yellow spot at a distance of several metres. When the bird alights on another inflorescence, the sharp thrusting motion of the head ensures the forcible transfer of pollen to the small stigmatic groove on the pollen persenter.

Three species of sunbird, *Nectarina famosa* (L.), *Anthobaphes violacea* (L.), and *Cinnyris chalybeus* (L.) are of equal importance as pollinating agents. Although they are distinctly territorial, particularly in the breeding season, the present author has observed all three species feeding simultaneously in a large shrub of *L. praemorsum* on the Nardouwberg. These species have also been found to be dominant in coastal macchia (Winterbottom, 1968), even increasing in numbers when Ericaceae and Proteaceae are flowering. Pollen spots on the head and sometimes at the base of the bill have been observed in all three species.

The Redwing Starling, *Onychognathus morio* (L.) and the Cape weaver, *Ploceus capensis* (L.) have been observed on several of the larger flowered species of *Leucospermum*, attempting to obtain nectar by puncturing the perianth tube. However, although pollen has been seen on the heads of both these species, they are only casual visitors and probably do not play a very significant role in pollen transfer.

Insect Pollinators

The inflorescences of *Leucospermum* attract a large insect fauna (Gess, 1968) but comparatively few of these insects (mainly Diptera, Hymenoptera and Curculionidae) appear to be pollinators. Marloth (1908) reported *Trichostetha fascicularis* and *T. capensis* as insect pollinators in *Leucospermum*. These

observations have been confirmed by the present author while several additional Scarab beetles have been found to be important pollinators. *Trichostetha albopicta* (Gor. Perch) has been observed on several species in the southern Cape, often in association with a smaller even commoner species, *Peritrichia capicola* (F.). Both these species have been observed in considerable numbers on a single inflorescence. By far the most commonly encountered Scarab beetle is *Anisonyx ursus* (F.). This species has been found at many places in the south western Cape on a wide range of species of *Leucospermum* and is considered the most important insect pollinator of this genus. It is not unusual to find three or four individuals feeding on a single inflorescence.

All the Scarab beetles discussed have a comparatively brief period of pollinating activity which lasts from the end of August until mid October. On warm days in September when the atmospheric humidity is high, many thousands of *Anisonyx ursus* can be seen in a population of *Leucospermum*. All the species studied appear to be strong flyers. When alighting on an inflorescence they land on the projecting pollen presenters. Pollen shed from the pollen presenters adheres to the setae on the ventral surface of the head and thorax. They then burrow down through the perianths to feed on nectar in the perianth tubes. Visits to each inflorescence may last up to 30 minutes or more. On leaving the inflorescence the insect clambers through the pollen presenters before taking to flight and again pollen is brushed onto the setae.

Discussion

The field observations recorded here merely prove that the feeding patterns of certain birds and insects result in the transfer of pollen from one plant to another. Nevertheless, although the receptive stigmatic groove on the pollen presenter is very small, usually 0,25—0,5 mm long, controlled pollination experiments have shown that even the light brushing of pollen onto the stigmatic groove results in fertilization. Thus it is likely that pollination is effected by even the smallest and lightest of the Scarab beetles.

While the insects discussed here are undoubtedly important pollinators for a few weeks during spring, they are rather local in their importance for although they may be abundant in a population at one locality, they may be quite absent from a comparable population of *Leucospermum* a few miles distant. The bird species mentioned previously are generally ubiquitous, even to the extent of being found on isolated peaks in Karroid regions having a capping of Cape Flora. Moreover, they feed actively on the inflorescences for the full duration of the flowering period. These considerations, together with their greater mechanical efficiency in transferring pollen and the fact that they carry a greater pollen load than any insect, leads one to believe that birds are the more important pollinating agents in *Leucospermum*.

Phytogeography

Introduction

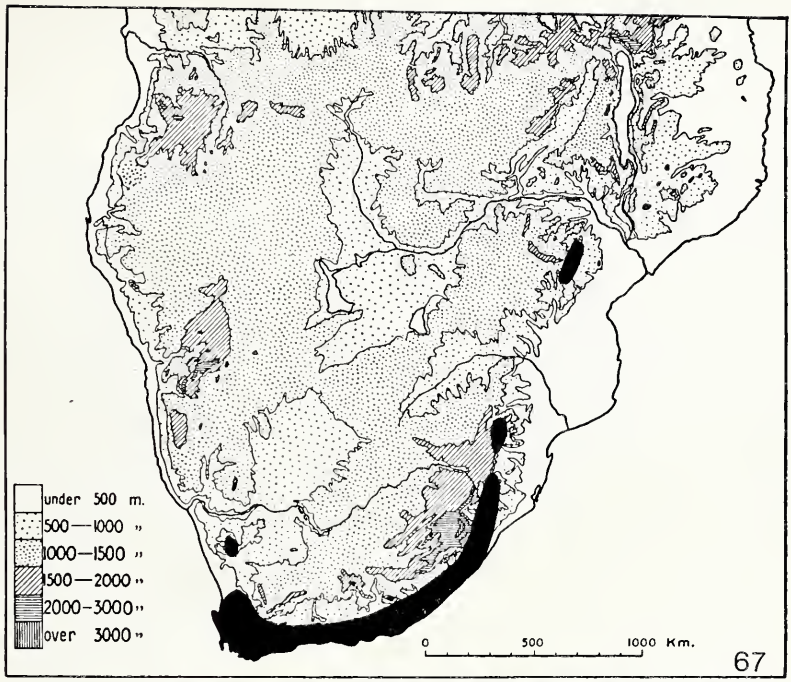
Having completed a taxonomic revision of *Leucospermum* and having mapped the distribution of each species, it is now possible to discuss the phytogeography of the genus. Problems such as the possible origin and migrations of *Leucospermum* are discussed in relation to the present day distribution of the genus and also to paleoclimatological and geological evidence. Vicarious taxa and the principal areas of speciation are also discussed.

Several diverse arguments have been proposed to explain the distribution and origin of the Proteaceae in Southern Africa. Largely on the evidence of the fossil record, Levyns (1958) suggested a northern origin for the family. Johnson and Briggs (1963) suggested that African members of the tribe Proteae were of tropical origin. In the present author's opinion, the arguments of Beard (1959) on the origin of the African Proteaceae, are the most satisfactory. Basing much of his evidence on the distribution and morphology of *Protea*, Beard maintained that while the Proteaceous flora of the south western Cape appeared to be of southern origin, it was more likely to have been derived from a tropical montane flora that was thought to have originated in Gondwanaland. As regards the distribution of *Leucospermum*, the present author has found a considerable amount of evidence to support Beard's theory.

Present Distribution

The genus *Leucospermum* with 47 species, is confined to Southern Africa. Its present range extends from the eastern highlands of Rhodesia through the eastern Transvaal Drakensberg to Swaziland and Natal and from there along the eastern and south eastern Cape coastal belt to the south western Cape, with outlying populations in Namaqualand (fig. 67). Only 3 species (*L. saxosum*, *L. gerrardii* and *L. innovans*) occur beyond the border of the Cape Province while 92% of the known species occur between Port Elizabeth and the Olifants River mouth (fig. 69). The greatest concentration of species, however, is found in a narrow belt along the southern Cape coast, between Stanford and the Breede River mouth, where 30% of the known species occur (figs. 69 & 71). This area will be discussed elsewhere.

The majority of species have rather small geographical ranges, several being confined to an area of about one square mile. Few species have distribution ranges that could be termed "wide", even in the narrowest sense of the word.



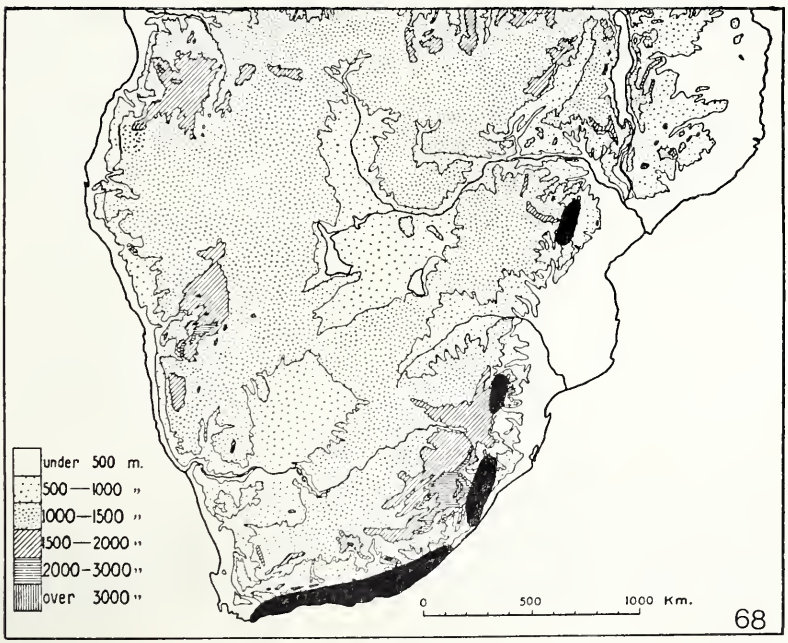


FIG. 67 AND 68.

(67) Distribution range of the genus *Leucospermum* R. Br.—(68) Distribution range of *Leucospermum* section *Crassicaudex*.

Thus, in many respects the distribution of *Leucospermum* parallels that of many typically Cape genera such as *Phylica* (Pillans, 1942), *Muraltia* (Levyns, 1954), *Cliffortia* (Weimark, 1934) and *Aristea* (Weimark, 1940).

Edaphic Factors Affecting The Distribution Of *Leucospermum*

As a general rule it may be said that the majority of *Leucospermum* species in the Cape are confined to acid soils derived from Table Mountain Sandstone. A few species occur on Witteberg Quartzite which weathers to form a leached, siliceous substratum that is equally as deficient in minerals. Beyond the borders of the Cape, the genus appears to be found on sandstones and quartzites.

There are, however, several species which occur chiefly on heavy clay soils derived from weathered Cape Granite (e.g. *L. gueinzii*, *L. grandiflorum* and *L. lineare*) while *L. calligerum* and *L. heterophyllum* have on occasions been recorded on Malmesbury gravel.

The distribution ranges of *L. praecox*, *L. fulgens*, *L. muirii*, *L. tomentosum*, *L. parile*, *L. rodolentum*, *L. arenarium* and *L. hypophyllocarpodendron* appear to be determined by the substratum, which in this case is deep, white, partly stabilized sand of Tertiary or Recent origin.

Likewise, *L. truncatum* and *L. patersonii* grow exclusively on limestone deposits of the Alexandria formation. These deposits form a ridge of limestone hills adjacent to the southern Cape coastline, between Danger Point and Still Bay. As no published information is available regarding the alkalinity of this habitat, pH measurements were made using a transistorised pH meter, checked against a standard buffer of pH 7. For example, at a site on the hills above De Hoop in the Bredasdorp district, the surface soil gave a p.H of 8,0 whereas the crushed parent limestone gave a pH of 8,3. At Grootbos near Gansbaai, the surface soil gave a pH of 8,3 and the crushed parent limestone a reading of pH 9,7.

These preliminary observations are indicative of the alkaline nature of this habitat.

It is difficult to estimate the role which different substrata have played regarding the distribution and migration of *Leucospermum* as several taxa appear to have become adapted to widely divergent edaphic conditions. Nevertheless, it is clear that sandstones, quartzites and occasionally granites are the main substrata on which species of this genus occur.

Leucospermum In The Summer Rainfall Regions

A persistent, subterranean rootstock and a narrowly cylindric involucral receptacle characterise the very natural section *Crassicaudex*. This section has the greatest range in the genus, and, with the exception of *L. cuneiforme*, which



FIG. 69.
Species density of *Leucospermum* in the Cape Province showing the high concentration of species (30%) along the Bredasdorp flats (blackened area).

also occurs in the southern Cape Province, all the other species placed in it are confined to the summer rainfall regions of Southern Africa (fig. 68). The distribution ranges of the four species making up the section *Crassicaudex* are all rather wide, and in some cases disjunct, when compared with the ranges of taxa endemic to the south western Cape. *L. cuneiforme* has the greatest range of all the species, both ecologically and geographically, occurring almost continuously from the Caledon district to the Transkei (fig. 8). In sharp contrast is the very disjunct distribution of its vicarious partner, *L. saxosum*, which has populations in the eastern highlands of Rhodesia and the eastern Transvaal Drakensberg, separated by the Limpopo interval.

In seeking an explanation for such a distribution one must postulate a connexion between the Drakensberg and Inyangani subcentres at some time in the past. This in turn presupposes favourable climatic conditions which would have permitted the joining of these subcentres. According to Brain and Meester (1964), the sequence of rainfall changes in Southern Africa during the Quaternary followed a cyclical pattern: Plio Pleistocene (1–2 million years ago); 1st pluvial; 1st non pluvial; 2nd pluvial; 2nd non pluvial; 3rd pluvial; present. The only quantitative estimates of these variations have been made by Bond (1957) and Brain (1958), working on sites in Rhodesia and the Transvaal

respectively. Largely as a result of their work, it is now generally considered that the mean annual rainfall during the Pleistocene varied from 60% of the present rainfall during non pluvials to 140% of the present rainfall during pluvials. Cooke (1964) has even suggested that these values may have been exceeded during certain phases.

Fluctuations in the Pleistocene climates in Africa have been confirmed by palynological research (van Zinderen Bakker, 1964). Moreover, these studies have led van Zinderen Bakker (l.c.) to suggest that during the last major pluvial in east Africa, a decrease in temperature of 5°C occurred (equivalent to a decrease in altitude of 500 m).

However, as Wild (1964, 1968) has already pointed out, neither the increases in rainfall nor the decreases in temperature currently postulated to have occurred during the Pleistocene are sufficiently great to have resulted in a continuous connexion between Drakensberg and Inyangani subcentres being established. To date, the most satisfactory means of explaining this connexion has been put forward by Wild (1964, 1968), who suggested that the Cape Centre and its subcentres were connected by the Early Tertiary. He points out that in a geomorphological map of Africa (King, 1962) showing the denudational land surfaces, the Cape Centre and its subcentres are shown as continuous during the Early Caenozoic. An even land surface would have allowed the Cape Flora to have covered a large continuous area of Southern Africa by the Early Tertiary. Folding, which, according to King, took place largely in the Pliocene, would have resulted in the fragmentation of what Wild (1964: 132) has termed the "Cape Flora or its direct evolutionary precursor" and which would then have only survived in Central Africa in montane areas.

The Western Cape Coastal Sandflats

Another very natural group is the section *Leucospermum* with five species, distributed almost entirely along the Western Cape coastal sandflats, between Cape Town and Heerenlogementberg. Outlying populations are found in the Breede River valley at Brandvlei and along the Bredasdorp coast (fig. 70).

The distribution of all these species appears to be determined by edaphic factors since they grow only on deep white sandy soils, generally considered to be of Pleistocene origin (du Toit, 1966: 441). They are only very rarely found on Table Mountain Sandstone. It is probably significant that within the areas occupied by these five species (apart from a marginal stand of *L. calligerum* on an intrusion of Malmesbury gravel) there are no other species of *Leucospermum* competing in this particular environment. Thus the entire *Leucospermum* flora of the coastal sandflats habitat is made up of one or other of the vicarious species in the section *Leucospermum*. It would seem that the species of this

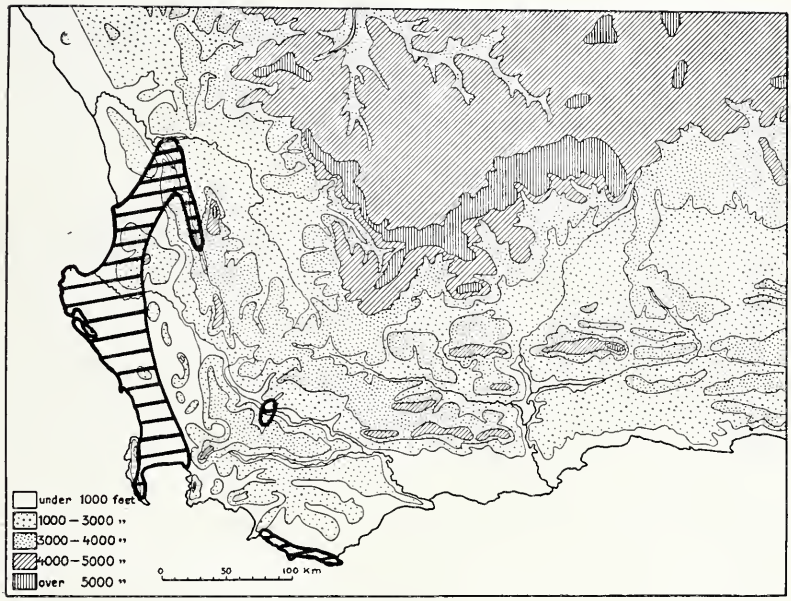


FIG. 70.
Distribution range of *Leucospermum* section *Leucospermum*.

section have developed on a substratum that is geologically relatively recent and was moreover subjected to marine regressions and inundations. To suggest that the five species comprising section *Leucospermum* have probably evolved since the Pleistocene is therefore not unreasonable.

The distribution of *L. hypophyllocarpodendron* ssp. *hypophyllocarpodendron* requires some explanation. The populations along the Bredasdorp coastal flats are separated from the populations on the Cape Flats by a formidable ecological barrier, namely the Hottentots Holland mountains. At the present time there are no low lying coastal sandy areas which could link the two above-mentioned areas of distribution.

Hamilton & Cooke (1965: 336) have indicated on their map the position of the coastline between the Cape Peninsula and Cape Agulhas during the marine regression of the Middle Pleistocene. The Middle Pleistocene coastline (according to Hamilton & Cooke) has been marked on the distribution map of *L. hypophyllocarpodendron* ssp. *hypophyllocarpodendron* (fig. 39). Assuming that

their interpretation is correct, a land bridge would have linked the Bredasdorp coastal flats and the Cape Flats, providing a migration route which is likely to have been ecologically suitable for this species. Subsequently, when the sea returned to its present level, complete isolation between the Bredasdorp coast and the Cape Flats would have been achieved.

The Southern Cape Coastal Flats

The greatest concentration of species is found in the Bredasdorp district. Here, 30% of all the known species are confined to a narrow strip along the coast between Stanford and the Breede River mouth and most of these are still further restricted to the Bredasdorp beds which are from two to twelve miles wide (fig. 71).

During the Tertiary and Pleistocene, much of this area was subjected to marine invasions and regressions (du Toit, 1966; Hamilton and Cooke, 1965: 335). Consequently, it may be regarded as a disturbed habitat. In addition, the presence of Table Mountain Sandstone, limestone outcrops of the Alexandria formation, sandy surface deposits of Recent origin and Malmesbury gravels, have afforded a wider range of habitats than is normally available for colonization in such a small area in the south western Cape. Several pairs of ecological vicariads have developed on the different geological formations, each species being very specific in its edaphic requirements. For example, *L. cordifolium* occurs on Table Mountain Sandstone while its vicarious counterpart *L. patersonii* grows only on limestone. *L. truncatum* is confined to limestone while *L. fulgens* grows only on partly stabilised sand, of Recent origin. Apart from these, several other vicarious pairs (e.g. *L. prostratum* and *L. pedunculatum*, *L. calligerum* and *L. heterophyllum*) are prominent in this area.

Thus there are several closely related species growing in adjacent localities in an area which has experienced surface disturbances since Pleistocene times. It is therefore not unduly speculative to suggest that a situation exists in the Bredasdorp coastal flats which can be regarded as being indicative of rapid evolution, if the views of Stebbins (1957: 549) are held to be correct.

Montane Areas In The South Western Cape

It has been stressed by van Zinderen Bakker (1964: 33) that we do not know whether the cool-humid periods of the south western Cape Province during the Pleistocene were contemporaneous with those in the Transvaal and Rhodesia. Nevertheless, during a hypothermal minimum, the anticyclones of the middle latitudes to the south of Africa, would have been in a more northerly position than at present. To quote van Zinderen Bakker (1967: 144), "the consequence of this would have been that the winter rainfall area was much more extensive,

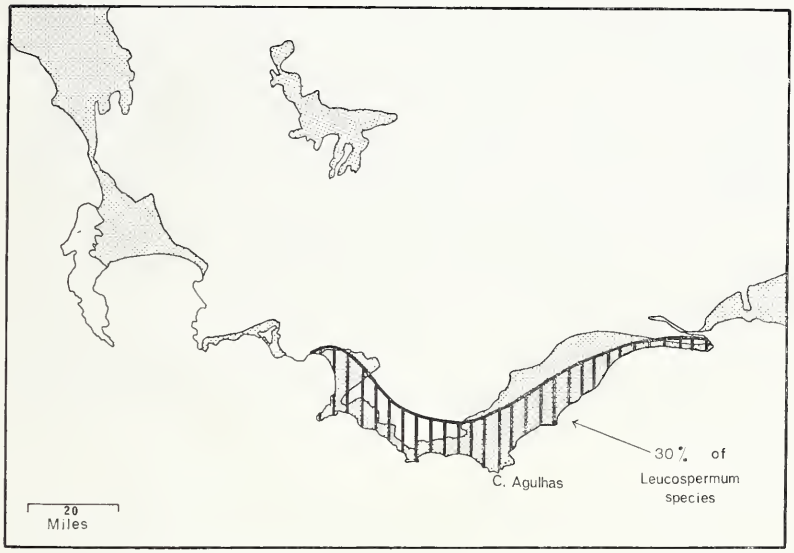


FIG. 71.

Map showing the high concentration of species of *Leucospermum* along the Southern Cape coastal flats in the Bredasdorp district, where 30% of the species in the genus occur within the area hatched with dark vertical lines. The stippled area represents unconsolidated superficial deposits of limestone, sand and conglomerate mainly Tertiary to Recent in age and Table Mountain Sandstone. (Adapted from the 1:500 000 geological map by F. C. Truter and P. J. Rossouw, Government Printer, 1955).

as cyclonic rain could penetrate much further inland". Such conditions would have enabled the Cape Flora to spread eastwards and even to reach isolated mountains in the interior. During a hyperthermal period, drier conditions would have prevailed, restricting the winter rainfall area to an even smaller area of the south western Cape than is the case at present.

In a region of dissected topography like the south western Cape, one of the effects of fluctuations in the rainfall would have been to cause the fragmentation and eventual isolation of populations on the higher peaks, during arid periods. This effect would have been most pronounced in marginal areas where the boundary between the Cape and Karroo floras is determined mainly by rainfall.

Noteworthy cases are the isolated populations of *L. alpinum* on the Kamiesberg and Cold Bokkeveld mountains which have differentiated sufficiently to be regarded as subspecies. Likewise, the isolated population of *L. obtusatum* on the Witteberg is considered subspecifically distinct from the main populations

on the Worcester and Montagu mountains (fig. 52). Climatic conditions prevailing today are such that migration between the four centres marked in fig. 53 is impossible. It seems reasonable to assume that during a hypothermal period, a single variable complex was distributed over this range. Subsequently, during periods of greater aridity populations survived only on the higher peaks such as the Kamiesberg, Cold Bokkeveld, Witteberg, Worcester and Montagu mountains, eventually differentiating into two species, each of which can be separated into geographically isolated subspecies.

L. calligerum and *L. wittebergense* are a similar pair of vicarious species. *L. wittebergense* probably developed on the dry Witteberg-Swartberg range due to long standing isolation brought about by an increase in the aridity of the region (fig. 45).

Similarly, one can explain the isolation and differentiation of *L. profugum* and *L. spathulatum* on the Piketberg and the Cedarberg-Cold Bokkeveld mountains respectively, from a variable continuous population that was probably more widespread in the past.

Discussion

The available phytogeographic and palaeoclimatological evidence points to the likelihood that the four vicarious species of the section *Crassicaudex* have had a lengthy history in Southern and South Central Africa. The ancestral population from which they could have been derived was probably in existence by the Early Tertiary or even earlier while their survival in these areas may be ascribed to their adaptation to burning by means of the persistent rootstock. The early development of the rootstock or lignotuber in the seedling stages is indicative of the high survival value of the character, which although undoubtedly secondary, is probably a fairly long established adaptation.

Morphologically, the inflorescence might be considered relatively simple in *L. saxosum*, *L. cuneiforme*, *L. innovans* and *L. gerrardii* as the involucral receptacle in these species is narrowly cylindric suggesting that it is merely a condensed spike. A conic, conic-depressed or flattened involucral receptacle is found in the remaining species of the genus. If fusion and reduction can be regarded as being indicative of evolutionary advancement in the inflorescence, it can be argued that the narrowly cylindric involucral receptacle exemplifies the primitive condition.

Conversely, the situation in the south western Cape suggests that speciation has taken place relatively recently. The geographical isolation brought about by climatic fluctuations during the Pleistocene is likely to have been an important factor in promoting speciation in *Leucospermum* particularly in montane areas. Since the Pleistocene, the availability of new habitats, mainly along the southern and western Cape coastal flats, also appears to have resulted in rapid speciation

in *Leucospermum* as is evidenced by the number of vicariads in these regions. Moreover, on morphological grounds the inflorescences of these species can be regarded as being advanced.

It is therefore the opinion of the present author that the species density in the south western Cape is largely due to speciation in Pleistocene and post Pleistocene times. These taxa are thought to have been derived from a supposedly more primitive type such as presently occurs in the summer rainfall areas of Southern Africa.

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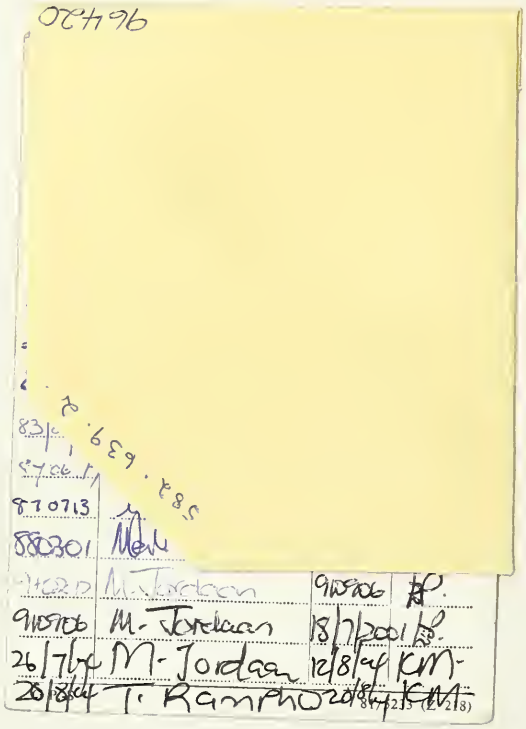
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